

18. The study proposes modifications to stabilize the shoreline. The recommended plan consists of several features: (1) constructing 3 new timber groins, (2) placing approximately 3,000 cubic yards of material onto the beaches, and (3) removing and replacing 25 timber groins.

19. As provided by Section 111 authority, the cost of work to correct the erosion attributable to the navigation project at Miami Harbor will be a 100% Federally funded responsibility. The benefits consist of the stabilization of the shoreline at Virginia Key and the preservation of the historical Virginia Key Beach Park.

20. Potential sources of sand for the beach placement will come from the upland confined disposal facility on Virginia Key, which could receive sand from maintenance of the Miami Harbor Federal channels or from new construction modifications under consideration for the harbor in this report.

VIRGINIA KEY RESTORATION – CONTINUING AUTHORITY PROGRAM, SECTION 1135, MIAMI-DADE COUNTY

21. Currently in progress, the proposed project will consider restoration of native plant communities in selected areas on Virginia Key. These areas currently contain a high percentage of exotic vegetation, primarily Australian and Brazilian pepper. The restoration plan includes removing exotic vegetation from the environment and replacing them with the historic plant communities including mangrove, coastal strand, tropical hardwood, and aquatic/wetland species. The proposed project would restore tropical hardwood hammock, wetlands, coastal strand, freshwater pond and provide for selective clearing. This would provide a more suitable habitat for fish and wildlife resources than what currently exists.

PLAN FORMULATION

22. Section 904 of the Water Resources Development Act of 1986 requires the Corps to address the following matters in the formulation and evaluation of alternative plans:

- a. Enhancing national economic development, including benefits to particular regions that are not transfers from other regions.
- b. Protecting and restoring the quality of the total environment.
- c. The well-being of the people of the United States.
- d. The prevention of loss of life.
- e. The preservation of cultural and historical values.

23. The planning process on the Federal level aimed to assist in the formulating and evaluating water resources projects is the National Economic Development objective or NED. The NED principle provides policy guidance to help Federal water resources planners define problems and develop solutions. The NED process ensures the recommended project maximizes net benefits. The process also ensures the recommended project outputs, defined, as the benefits to the Nation from the use of the resource, will exceed the cost implementing the project.

24. The Federal objective in water and related land resources planning is to develop a plan, which would provide the maximum contribution to the NED objective consistent with protecting the Nation's environment. In accordance with this policy, the following apply to the Miami Harbor navigation study for developing structural and non-structural plans. The Federal planning process consists of the following major steps:

- a. Defining of the water and related land resource problems and opportunities associated with the Federal objective and specific state, county, and municipal concerns.
- b. Inventory, forecast and analyze water and related land resource conditions within the planning area relevant to the identified problems and opportunities.
- c. Formulation of plans.
- d. Comparison of plans.
- e. Select a recommended plan based on the comparison of plans.

25. Improvements to the existing navigation project, which would improve the operational efficiency and safety for deep draft commercial vessels by providing a deeper channel with widening in certain areas are considered. Such deepening and widening reduces vessel operation costs on the existing project. This results in national benefits in transportation cost savings.

26. The assessment of water and related land resources problems and opportunities specific to the study area includes an evaluation of existing conditions and future without project conditions.

PROBLEMS AND OPPORTUNITIES

27. The problems and opportunities of the study area provide direction for the study. The initial request for harbor improvements focused on reducing ship groundings at the beginning of the entrance channel from variable and unpredictable crosscurrents, the turn from the entrance channel to Fisherman's

channel due to difficult crosscurrents, vessel turning in the Fisher Island and Lummus Island turning basins, and surge impacts on ships moored along Lummus Island.

Existing Conditions

28. Miami Harbor is in Biscayne Bay, a shallow salt-water sound on the Atlantic Coast near the southern end of the Florida peninsula. The bay has a length of about 38 miles and a width that varies from three to nine miles wide with average depths of 6 to 10 feet. A narrow chain of small islands known as keys separate the bay from the Atlantic Ocean. Shallow natural passages between the keys along with artificial cuts through the peninsula such as Bakers Haulover Inlet and Government Cut connect the bay with the ocean. Government Cut, near the south end of the peninsula, forms the entrance to the main ship channel leading to Miami Harbor. The City of Miami is located on the western shore of Biscayne Bay. Miami Harbor is about 23 miles south of Port Everglades and 130 miles northeast of Key West Harbor.

29. Miami Harbor provides access to deep draft vessel traffic using terminal facilities located in the Port of Miami. According to the Port of Miami, 2001 Official Directory, those port facilities handled in fiscal year 2000 over 7.8 million tons of cargo a year. That total includes about 4.5 million import tons and 3.3 million export tons. That total also represents a 13 percent increase over 1999 totals. The Port of Miami continues to rank in the top 10 cargo container ports in the United States and remains the largest container port in Florida. As a result of cruise ship operations over 3.3 million passengers traveled through the Port of Miami.

30. The Port offers the greatest frequency of cargo service, with the largest number of shipping lines, calling at the most destinations, in the world. The Port has more than 35 shipping lines calling on over 100 countries and over 254 ports. In addition to its strength as a cargo port, the Port is also the largest multi-day cruise passenger homeport in the world. The Port's link to important trading and cruise routes, as well as the strength and characteristics of its large and growing hinterland, have positioned the Port as a top performer, and will continue to drive the Port's growth as long as the infrastructure to support marine transportation is in place. The total economic impact of Port operations on the nation is estimated at more than \$8 billion per year. More than 45,000 jobs are directly or indirectly attributable to Port operations. Jobs created by Port and trade activity tend to be good jobs: they pay significantly more than other job growth sectors in the local economy, have better long-term opportunities for employees and offer better training programs (particularly for minorities). The Port also utilizes the local, regional, and inter-regional transportation network components consisting of roads, railway lines, and channels to facilitate the efficient movement of goods and passengers.

Tributary Area

31. The immediate tributary (hinterland) area for Miami Harbor includes Miami-Dade County, which depends on the port for some basic commodities. Containerization of general cargoes and the expansion of port properties by dredge and fill operations has opened Miami Harbor to the transport of high value manufactured products, machinery, foodstuffs, and transportation equipment. Much of that cargo originates in the central section of the United States for export to Latin America. Also, with the expansion of port facilities, Miami Harbor has become a major distribution port for cargo shipped from Europe and the Far East bound for Latin and Central America.

32. According to the Port of Miami, 2001 Official Directory, Miami Harbor facilities process nearly 50 percent of all U.S. exports to the Caribbean and Central America, and more than 30 percent of all U.S. exports to South America. More than 40 shipping lines calling on 132 countries and 362 ports around the world operate from the Port of Miami. Markets served by those carriers include Africa, Asia, the Caribbean, Central America, Europe, the Middle East, North American, and South America.

33. Virtually all the liquid bulk shipped through the Miami Harbor is handled by the liquid bulk facility on Fisher Island known as the Coastal Refining and Marketing, Inc. The Port of Miami, located in environmentally sensitive Biscayne Bay, considers itself a "clean port" since it does not handle bulk cargoes or potentially dangerous or hazardous cargoes such as fuel oil.

Waves

34. The waves that occur in the vicinity of the study area consist of "sea" and "swell". "Seas" consist of waves generated by local winds and generally travel in the same direction as the wind. Swells involve waves generated from distant storms or open ocean prevailing winds that enter the study area independent of local winds. Swells out of the north and middle Atlantic cannot reach the study area without modification of wave pattern or wave energy in the shallows of the Bahama Banks or by refraction along the Florida shoreline to the north. Locally-generated seas occur with the greatest frequency, but the less-frequent large storm swells create the most adverse conditions for navigation in the project area.

Tides and Currents

35. Tides within the Miami area are semi-diurnal; there are two high and two low tides each day. The mean range at Miami Beach is 2.5 feet (3.0 - foot spring range) and the lowest recorded tide is 1.4 feet below mean low water. The most

significant ocean current in the region is the Gulf Stream current off the east coast of Florida, which flows north and varies in velocity from 17 miles per day in November to 37 miles per day in July. The Gulf Stream is separated from the project area by the narrow band of the continental shelf, and has little direct impact on the project area. Tidal currents generated by the astronomical tides produce a greater impact on the project area. Maximum tidal current velocities through Government Cut are ordinarily about 5.5 feet per second on an average tide, but occasional velocities of 6.2 feet per second have been recorded during spring tide. From September through February, waves and prevailing winds are predominantly from the northeast and east. During March, April, and May, winds and waves are usually easterly.

36. The United States Coast Guard warns of strong tidal currents in the entrance between the jetties. A northerly wind causes a considerable southerly set across the ends of the jetties. Vessels are advised to favor the southerly side of the entrance channel during southerly winds, as a pronounced northerly set may be experienced. See figures 1 and 2.

37. The Biscayne Bay Pilots report variances between predicted and actual currents. Cross-channel current variations in Government Cut are particularly difficult to negotiate. Caution should be exercised when entering Government Cut from the sea during flood tide with northeasterly winds; a strong turning torque occurs when the bow is just inside the north jetty. A similar but less serious situation occurs when leaving the port during ebb tide. Horizontal current gradients, which may make maneuvering difficult, occur in the turning basin north of Fisher Island. See figures 1 and 2.

Bridges

38. The Port is connected to the Miami mainland by two bridges, figure 1; a 65-foot vertical clearance, fixed span vehicular bridge with a horizontal clearance of 90 feet, and a bascule rail bridge with a vertical clearance of 22 feet at center and a horizontal clearance of 90 feet. It is linked to the Florida East Coast Railroad Company's main line track.

Utilities

39. The Miami-Dade Water and Sewer Department (WASD) owns a force sewer main in a submarine crossing within Component #2A, figure 3, leading from Miami Beach to its Fisher Island treatment plant. The crossing consists of a 54-inch concrete pipe running under the riverbed with top of pipe elevation at elevation -50 feet. The 54-inch force sewer main will require relocation if any additional depth is justified. The Engineering Appendix contains additional detail on the utility relocations; see Plate B-18 for location of the utilities. Additionally, WASD owns a water main in a submarine crossing leading from Fisher Island to Lummus Island. This crossing consists of a 20-inch ductile iron pipe running

under the riverbed with top of pipe elevation at elevation –53.0 feet. The WASD water main requires relocation for any proposed project depths.

40. The Florida Power and Light Company (FP&L) owns two transmission lines in a submarine crossing leading from its Fisher Island plant to Lummus Island. The crossing consists of one 69 kV circuit and one 138 kV circuit each inside 24-inch pipe conduits with top of pipe elevation at elevation –45.8 feet and 45.6 feet Local Mean Low Water (LMLW). Those cables should have been relocated under the previously authorized phase I deepening. Removal will occur as part of a new Project Cooperation Agreement (PCA) with Miami-Dade County Seaport Department in which the Corps will complete construction of the phase II project previously started under a 204e agreement by the port authority. As such, the FP&L transmission lines are part of the without project condition.

Existing Terminal Facilities

41. The Port of Miami is a 660-acre island facility developed from placement of dredged material to initially form two islands, Dodge Island and Lummus Island. Additional development connected the western end, Dodge Island, with the eastern end, Lummus Island as shown in figure 1.

42. As previously mentioned, the Port of Miami is a “clean port” (i.e., the designation of a seaport that does not handle bulk cargoes or potentially dangerous or hazardous cargoes such as fuel oil). The Port handles only palletized, roll-on/roll-off (RO/RO), and containerized cargo. In addition to cargo traffic, the Port of Miami is also a major cruise ship port. It is the year-round homeport of the largest cruise ship in the world, the VOYAGER OF THE SEAS. As reported in the 1999 Port of Miami Master Development Plan (April 30, 1999), the Port consists of 518 acres of actual landmass. Of the 518 acres, 372.5 acres (71.9 percent) is devoted to cargo operations, mainly on Lummus Island, and 52 acres (10.0 percent) is devoted to cruise operations on Dodge Island. The Port also leases 34 acres from the Florida East Coast Railway at its Buena Vista yard, which is located approximately 2.5 miles northwest of the Port. This leased property is used as an intermodal container marshaling and storage area for transshipments.

43. In addition to 10 existing gantry (3 panamax and 7 post-panamax) there are two super panamax cranes scheduled for delivery with an option for two more on order. The Port’s cargo handling equipment includes forklifts, toploaders, and mobile truck cranes including three Mi-Jack 850-P Rubber Tire Gantries (RTGs), which allow containers to be stacked 6-wide and 4-high. There are eleven passenger terminals that accommodated 3.3 million passengers in Fiscal Year 2000. The Port’s passenger terminals are designated Terminals 1 through 5, Terminal 6/7, Terminal 8/9, Terminal 10, and Terminal 12 (figures 1, 4, and 8). As identified in the Port’s 1999 Master Plan, approximately 47.5 acres of the Port’s land area is utilized by support facilities: parking, 17.0 acres; circulation

and open space, 10.5 acres; office – Federal Government, 8.5; recreation, 7.5 acres; office-miscellaneous and office-Seaport Department, 1.7 acres.

44. CSX Transportation, Inc serves the Port of Miami. The Miami-Dade County Seaport Department owns 2.1 miles of trackage at the Port of Miami on Dodge Island, which consists of a main line track extending the length of the island and a four-track, closed-end intermodal rail yard. The main track on Dodge Island connects with the Florida East Coast Railway via a rail bridge. A connection with CSX Transportation, Inc. is effected through an interchange in the west part of the city of Miami. Also, the Port is less than one mile from major highways: Interstate 95 and Federal Route 1 via Interstate 395, and Interstate 75 via Dolphin and Palmetto Expressways. The Miami International Airport (MIA) is located on a 3,300-acre site about five miles northeast of downtown Miami.

45. There is a private petroleum facility at Fisher Island (see figure 1). This facility receives Number 6 fuel oil and diesel fuel by tankers and barge (integrated tug and barge units - ITBs). The fuel is used solely for bunkering the Port's cargo and cruise ships, which are bunkered at the berth by tank truck or by bunkering barge. This facility has an 800-foot long berth with a depth of 36 feet and 12 storage tanks having a total capacity of 667,190 barrels.

46. As reported in the U.S. Army Corps of Engineers' Port Series No. 16 document (revised 1999), within Metropolitan Miami and Dade County 12 companies operate warehouses having a total of over 1,000,000 square feet of dry storage space and over 6,000,000 cubic feet of cooler and freezer space. All except three of the warehouses have railroad connections, and each is accessible to arterial highways. Anchorage for deep-draft cargo vessels lies north of the entrance channel to Miami Harbor. There are no bridges crossing the shipping channels for Dodge and Lummus Islands.

Cargo Movement and Fleet Composition

47. The vessels currently calling at Miami Harbor range in size from small general cargo vessels to Royal Caribbean International's Voyager-class cruise ships (length overall, 1,021 feet; breadth, 156 feet; draft, 28 feet). The largest dry cargo vessel class is the Panamax class of containership (length overall, 965 feet; breadth, 106 feet; draft, 44 feet). A Panamax class vessel is a vessel with dimensions that allow it to transit the Panama Canal: 950 feet long with a beam of 106 feet, except for passenger and container ships, which may have a length of 965 feet (lock dimensions are 1,000 feet long and 110 feet wide).

48. The Port of Miami handles container, trailer, neobulk (united/bundled), and breakbulk (loose non-containerized) cargo. The Port Authority records for fiscal year 2000 (October 1999 to September 2000) report a total of 7,804,946 short tons of cargo. Containerized cargo represented about 61.8 percent of all cargo; trailer, 35.6 percent; and neobulk and breakbulk, 2.6 percent. Cargo vessels

recorded 2,424 calls, or 70.3 percent of all ship calls (3,447). The cargo is carried on container ships, Roll-on/Roll-off (RO/RO ships), and Load-on/Load-off (LO/LO ships). The LO/LO ships have on-board cranes, and are primarily used in the Caribbean and Latin American trade, as many of the ports in these trade areas do not have gantry cranes. The trailer cargo is carried on the RO/RO ships that, except for auto carriers, carry containers. Most cargo is carried on “cellular” container ships that are designed to carry only containers.

49. Most of the container and trailer cargo recorded at the Port is classified as general cargo, not otherwise specified (N.O.S.). Examples of individual classes are refrigerated fruits and vegetables, miscellaneous apparel, textiles, and foodstuff. Buses and trucks are examples of breakbulk cargo. Lumber is an example of neobulk cargo.

50. In addition to handling cargo traffic, the Port of Miami is a major homeport for 17 cruise ships belonging to Carnival Cruise Lines, Norwegian Cruise Line, and Royal Caribbean International. These companies offer 4 to 11 day cruises. For fiscal year 2000 there were 3,364,643 passengers embarked/disembarked, and 1,023 ship calls were recorded, representing 29.7 percent of the total number of calls.

Current Trade Routes/Vessel Itineraries/Historical Tonnage

51. General patterns were identified for the container ships calling at Miami Harbor. For the European, Mediterranean, and Asian trade regions, the overall general itinerary pattern is that Miami Harbor is part of an itinerary in which it is not the originating port, nor is it the first or the last port of call. This pattern is generally true for the U.S. ports within the itineraries, but there are exceptions where Miami Harbor is the first, or the last U.S. port of call. The container ships are mainly foreign-flag, Panamax size, with a cargo capacity of 2,500- to 4,500-TEUs. However, for the Latin American and Caribbean trade routes Miami Harbor is the port of origin within the itinerary. The container ships are also mainly foreign-flag, but are smaller in size than those on the European, Mediterranean, and Asian trade routes. The maximum cargo capacity is 3,700 TEUs.

52. European export cargo destined for the United States east coast ports is usually carried on container ships that typically call first at Halifax, Canada, or New York/New Jersey, United States. These container ships then call at ports along the U.S. east coast unloading import cargo and loading export cargo. With respect to Miami's position in the itinerary, at this time Charleston is typically the prior port of call. After calling at Miami, the itineraries vary.

53. Container ships in the Mediterranean/United States East Coast Container Trade have itineraries that are similar to the itineraries in the European/United States East Coast Container Trade. There is one significant difference. Some of

the Mediterranean itineraries are actually part of an Asia/Mediterranean/United States East Coast itinerary, which includes transiting the Suez Canal. As these vessels do not transit the Panama Canal and the Suez Canal and have a maximum vessel draft of 56 feet, the only potential constraint to the efficient utilization of Post-Panamax container ships would be the depth at United States East Coast ports.

54. Asian containerized cargo arrives at United States East Coast ports on container ships that have either transited the Panama Canal or the Suez Canal. Container ships transiting the Suez Canal typically stop at Mediterranean ports; then continue on to United States East Coast ports (Asia/Mediterranean/United States East Coast itinerary). The alternative itinerary includes transiting the Panama Canal.

55. Latin American and Caribbean trade represents a significant portion of Miami Harbor's cargo activity. Latin American trade includes ports in Mexico, Central and South America. The vessel itineraries in this trade form a pattern that is similar to those in the European, Mediterranean, and Asian trade routes, except that in some itineraries, Miami Harbor is the originating port. The typical pattern is for the container ships to combine calls at various U.S. East Coast ports and Latin American and/or Caribbean ports. Most often, a shipping company will have a separate itinerary for the west and east coasts of South America. The itineraries that involve the west coast of South America include a transit through the Panama Canal. Because of the relatively shallow harbor depths and the absence of landside gantry cranes at ports in Latin America and the Caribbean, the container ships usually have onboard cranes for cargo handling. Site conditions at the ports and the onboard cranes, necessitate the container ships to be smaller than those used in the European, Mediterranean, and Asian trade routes. Furthermore, the lack of landside gantry cranes is also a reason for the extensive use of RoRo vessels, which carry trailers, as well as containers.

56. **Table 2** displays the historical imports tonnage for the Port from 1990 to 2000 by region. **Table 3** displays the historical export tonnage for the Port from 1990 to 2000 by region. **Table 4** displays the import and export distribution by commodity group for Fiscal Year 2001. As can be seen from these tables both imports and exports have more than doubled in this 1990 to 2000 time period.

Table 2 - Miami Harbor: Import Tonnage by Region

<u>Data years: 1990-2000</u>									
Short Tons									
Fiscal Year	Caribbean	Central America		Far East, Asia, Pacific		Middle East, SW Asia, Africa	North America	South America	Total
		& Mexico	Europe					Other	
1990	259,214	412,452	502,519	278,654	30,035	48,301	464,920	n/a	1,996,095
1991	212,968	383,924	451,645	352,150	35,452	35,040	514,258	n/a	1,985,437
1992	246,582	457,193	435,786	511,909	n/a	n/a	524,240	55,148	2,230,858
1993	267,945	467,618	564,551	571,726	n/a	n/a	664,935	60,338	2,597,113
1994	274,176	379,373	529,563	667,273	70,413	145,684	732,195	n/a	2,798,677
1995	314,712	555,833	734,177	793,022	84,462	137,324	844,645	n/a	3,464,175
1996	268,975	568,528	627,445	589,014	68,438	128,499	664,802	n/a	2,915,701
1997	284,386	655,709	750,589	573,791	45,007	200,019	781,115	n/a	3,290,616
1998	321,919	704,512	973,647	562,499	35,335	215,487	654,119	n/a	3,467,518
1999	303,656	713,142	1,252,393	605,068	26,925	214,279	624,140	n/a	3,739,603
2000	313,280	879,169	1,513,975	609,198	35,840	242,043	869,682	n/a	4,463,187
Source: State of the Port									

Table 3 - Miami Harbor: Export Tonnage by Region

<u>Data Years: 1990-2000</u>									
Short Tons									
Fiscal Year	Caribbean	Central America		Far East, Asia, Pacific		Middle East, SW Asia, Africa	North America	South America	Total
		& Mexico	Europe					Other	
1990	595,982	356,024	218,188	23,127	32,800	0	339,797	n/a	1,565,918
1991	544,142	443,928	208,866	24,706	37,964	3,714	598,092	n/a	1,861,412
1992	667,527	483,890	304,441	26,515	n/a	na/	810,849	42,123	2,335,345
1993	840,030	511,121	218,480	44,733	n/a	n/a	883,508	66,295	2,564,167
1994	798,601	332,974	239,168	182,237	15,704	314,615	892,276	n/a	2,775,575
1995	510,278	409,580	219,534	271,858	38,178	20,884	916,503	n/a	2,386,815
1996	608,729	533,994	317,411	284,664	51,709	63,236	1,194,350	n/a	3,054,093
1997	807,328	658,682	258,335	306,604	8,768	61,751	1,534,103	n/a	3,635,571
1998	994,965	624,387	260,153	242,831	9,548	82,875	1,517,254	n/a	3,732,013
1999	1,021,046	658,575	232,926	261,005	14,996	77,855	924,366	n/a	3,190,769
2000	894,252	719,388	344,650	278,311	9,042	73,348	1,017,768	n/a	3,336,759
Source: State of the Port									

Table 4 - Miami Harbor: Import and Export Distribution

<u>Import</u>	<u>Distribution</u>
Cargo Not Otherwise Specified (NOS)	Evenly distributed
Tiles, Stone, Cement	90% Europe; 10% S.A.
Fruits & Vegetables	75% C.A.; 15% Carib; 10% S.A.
Apparel	70% C.A.; 30% Caribbean
Beverages, Alcoholic	70% Europe; 15% Carib; 15% S.A.
Lumber & Wood	50% C.A.; 50% S.A.
Iron, Steel, Other Metal Products	50% S.A.; 50% Far East
Coffee	60% C.A.; 35% S.A.; 5% Carib
Seafood	60% S.A.; 40% C.A.
Wood Products	50% C.A.; 50% S.A.
<u>Export</u>	<u>Distribution</u>
Cargo NOS	Evenly distributed
Textiles	70% C.A.; 30% Caribbean
Paper, Newsprint	25% C.A.; 25% S.A.; 25% F.E.; 25% Europe
Food Products	35% C.A.; 35% Carib; 30% S.A.
Spare Parts	40% C.A.; 40% S.A.; 20% Carib
Iron, Steel, Other Metal Products	80% Far East; 20% C.A.
Building Materials	35% C.A.; 35% S.A.; 30% Far East
Electrical Machinery & Equip	40% C.A.; 40% S.A.; 20% Carib
Machinery & Industrial Equip	40% C.A.; 40% S.A.; 20% Carib
Trucks & Buses	40% C.A.; 40% S.A.; 20% Carib
C.A. = Central America	
S.A. = South America	
Carib = Caribbean	

Prospective Future Conditions

57. The container and trailer cargo class represents 97.4 percent of all cargo. The remaining 2.6 percent consists of neobulk and breakbulk cargo. Historical growth rates for these commodity types were computed for the 10-year period 1990 to 2000, (as shown in **Tables 2** and **3**). The historical growth rates were used as a basis to calibrate future growth for the 50 year period of analysis.

Future Cargo Traffic

58. Container cargo grew from 2,225,152 short tons in 1990 to 4,827,102 short tons in 2000, which represents a 117 percent increase, or a compound annual growth rate of 8.05 percent. For the 5-year period 1995 to 2000, the compound annual growth rate was about 3 percent lower (5.04 percent). This resulted from slower growth in export container trade for this period (1.98 percent). Container cargo exports recorded a compound annual growth rate of 6.46 percent for the period 1990 to 2000. Container imports demonstrated the most growth. From 1990 to 2000, the compound annual growth rate was 9.02%, and only about 2 percent lower for the period 1995 to 2000.

59. The overall compound annual growth rates of 9.02 percent for imports and 6.46 percent for exports are higher than the overall world and overall United States rates. As reported in Lloyd' Register's Fairplay Market Forecast - Container (February 2000), "Containership trade expansion has nearly doubled the world growth rate in the 1990s. Loaded TEU volumes averaged just under 7 percent annual growth in the 1990s." In "U.S. Industry & Trade Outlook 2000", The McGraw-Hill Companies reported an annual growth rate in United States liner import trade of 7.5 percent and 3.6 percent for United States liner export trade for the period 1993 to 1999.

60. In 2000, about 60 percent of the Port's trade (short tons) is in the Latin America and Caribbean (North-South) trade region. European trade represents about 24 percent, while the Far East trade represents approximately 11 percent. Domestic (North American) trade represents about 4 percent, while trade in the Middle East/Southwest Asia/Africa region represents 1 percent. The Far East and European trade regions grew faster than the Latin American and Caribbean regions, and are expected to do so in the future. U.S. and Asian trade has slowed in the last few years due to the Asian financial crisis. However, industry experts are predicting significant growth in the United States and Asia trade as markets continue to expand in China, and in developing countries like Vietnam.

61. Through the first 20 years (2009 to 2029) of the 50-year planning period (2009 to 2059), cargo average annual growth rates by trade region are based primarily on the historical average annual rates for the 10-year period 1990 to 2000 (see **Tables A-15** and **A-16** in the Economics Appendix). Any historical

average annual growth rates that exceeded the U.S. Labor Department's projected general overall annual rates of change for U.S. exports and imports through 2010 were adjusted to the Department's rates. This procedure capped average annual rates for imports and exports at 7.6 and 6.0 percent, respectively, resulting in significant reductions in the historical double-digit rates for cargo moving in the U.S. East Coast-Europe and Asia trade, as shown in **Tables A-15** and **A-16** of the Economics Appendix. Consistent with Corps guidance, the average annual growth rates for each trade region were reduced for the last 30 years of the planning period (2030 to 2059) based on a review of national, state and regional economic indicators.

62. This methodology resulted in an overall average annual growth rate of 4.75 percent for the period 2002 to 2059, and 4.53 percent for the period 2009 to 2059. In contrast, the overall average annual rate of growth for the period 1990 to 2000 was 8.07 percent (see **Table A-14** of the Economics Appendix). See the PORT AND INDUSTRY TRENDS section of the Economics Appendix for a detailed discussion of historical and future cargo traffic.

63. Neobulk and breakbulk ("Other") cargo represent 2 to 3 percent of all tonnage handled at the Port. Lumber, steel reinforcing bars, and paper are examples of this type of cargo. These commodity types have experienced overall negative growth: 1990 to 2000, -4.29 percent; 1995 to 2000, -6.68 percent. However, imports for the period 1995 to 2000 had a positive compound annual growth rate, 11.07 percent. Many of these commodities are dependent on construction activity, which is dependent on population growth and the general level of business activity and expansion. As such, it is anticipated that future compound annual growth rate for neobulk and breakbulk cargo will be between 1 and 2 percent for imports, while no growth is predicted for exports. For this analysis, a compound annual growth rate of 1.5 percent will be used for neobulk and breakbulk import cargo traffic.

64. It is assumed for this analysis that the compound annual growth rate for cruise ship passengers will be 2 percent, the same as the historical compound annual growth rate for the 10-year period, 1990 to 2000.

Problem Identification

65. Navigation Concerns: The Miami-Dade County Seaport Department provided correspondence (See letter dated October 23, 1997 in Pertinent Correspondence Appendix D.) from the Biscayne Bay Pilots outlining their concerns for the need to widen certain segments of the navigation channels in addition to the need for deepening. According to the harbor pilots several Maersk container ships have grounded off of buoy "1", figure 2, at the beginning of the entrance channel due to variable and unpredictable currents. The pilots have requested widening the entrance channel from an existing 500-foot width to

an 800-foot tapered entrance. The second location of proposed widening includes an area south of Government Cut between beacons 13 and 15, figure 3. That portion of the channel includes an area where ships turn from one channel into another.

66. Strong currents at that intersection of three different channels combined with the required decreased speed of the ship make it important to have as much swinging room as possible for the ship. Recently as August 30, 2001 a general cargo ship grounded in the location of Component #2A, figure 3. A third location for widening recommended by the harbor pilots includes the south part of the Lummus Island (Fisherman's) Channel, figures 6 and 7. Vessels docked along Lummus Island swing their onboard cranes 90 degrees out into the channel thereby blocking a portion of the channel. Under different conditions of wind, current, ship size and draft, passing those docked vessels results in an unsafe situation. Ships at dock sometimes experience a surging effect. The pilots suggest extending the southern edge of the Fisherman's channel 100 feet to the south. Other components for channel modifications relate to requests by the Miami-Dade County Seaport Department to expand their cruise ship terminals.

67. Information was requested from the Coast Guard for incidences of historical groundings, collisions, and allisions of vessels within the navigable waterways of Miami Harbor. This information was provided based on latitudinal and longitudinal data available on the coast guard database from 1992 to 2001. **Table 5** provides a summary of this information.

Table 5 - Coast Guard Vessel Groundings, Collisions, and Allision Incidences

cal_yr	month	service	vessel use	Incidence	location
2001	5	PASSENGER BARGE		ALLISION	CAUSEWAY ISLAND, MIAMI, FL
2001	5	COMMERCIAL		ALLISION	CAUSEWAY ISLAND, MIAMI, FL
1995	9	FREIGHT SHIP	BREAK BULK	ALLISION	CG BASE MIAMI BEACH FL
1995	9	PUBLIC VESSEL,UNC.		ALLISION	CG BASE MIAMI BEACH FL
1994	8	TANK BARGE	BULK OIL/PRODUCTS	ALLISION	DODGE ISLAND BRIDGE
1995	3	TOWBOAT/TUGBOAT		ALLISION	FISHERMANS CHANNEL
1995	3	TANK BARGE	OIL PRODUCTS	ALLISION	FISHERMANS CHANNEL
1999	9	FREIGHT SHIP	ROLL ON, ROLL OFF	GROUNDING	GOVERNMENT-CUT - POM
1996	3	TOWBOAT/TUGBOAT		GROUNDING	GOVERNMENT CUT
1995	10	FREIGHT SHIP	BREAK BULK	GROUNDING	GOVERNMENT CUT
1995	10	TOWBOAT/TUGBOAT		GROUNDING	GOVERNMENT CUT
1995	10	TOWBOAT/TUGBOAT		GROUNDING	GOVERNMENT CUT
1996	12	TOWBOAT/TUGBOAT	TOWING	ALLISION	GOVERNMENT CUT BUOY #16
1996	12	TOWBOAT/TUGBOAT		ALLISION	GOVERNMENT CUT BUOY #16
1996	12	FREIGHT SHIP	CONTAINER	ALLISION	GOVERNMENT CUT BUOY #16
1992	6	TOWBOAT/TUGBOAT		GROUNDING	GOVERNMENT CUT, MIAMI, FL
1994	3	FREIGHT SHIP	CONTAINER	ALLISION	LUMMUS ISLAND
1994	3	FREIGHT SHIP	CONTAINER	ALLISION	LUMMUS ISLAND
1997	12	FREIGHT SHIP	BREAK BULK	GROUNDING	MIAMI ANCHORAGE
1995	12	TOWBOAT/TUGBOAT		COLLISION	MIAMI ANCHORAGE
1995	12	FREIGHT BARGE	DREDGE	COLLISION	MIAMI ANCHORAGE
1995	12	RECREATIONAL		COLLISION	MIAMI ANCHORAGE
1994	8	FREIGHT SHIP	CONTAINER	GROUNDING	MIAMI ANCHORAGE
1993	3	PASSENGER	OCEAN CRUISE	ALLISION	MIAMI SHIP CHANNEL
1993	5	FREIGHT SHIP	BREAK BULK	GROUNDING	MIAMI, FL
2001	2	TANK BARGE	BULK OIL/PRODUCTS	GROUNDING	PORT OF MIAMI
2001	2	TOWBOAT/TUGBOAT		GROUNDING	PORT OF MIAMI
1997	12	PASSENGER	FERRY BOAT	COLLISION	PORT OF MIAMI
1997	12	RECREATIONAL		COLLISION	PORT OF MIAMI
1993	12	PASSENGER	PASSENGER O/B	COLLISION	PORT OF MIAMI
1993	12	TANK SHIP	BULK OIL/PRODUCTS	COLLISION	PORT OF MIAMI
1999	6	FREIGHT SHIP	UNCLASSIFIED	COLLISION	PORT OF MIAMI ANCHORAGE
1999	6	INDUSTRIAL VESSEL	DREDGE	COLLISION	PORT OF MIAMI ANCHORAGE
1997	1	PASSENGER	OCEAN CRUISE	ALLISION	PORT OF MIAMI TERMINAL 2
1994	1	FISHING BOAT		GROUNDING	PORT OF MIAMI, FLORIDA
1999	12	FREIGHT SHIP	CONTAINER	ALLISION	PORT OF MIAMI
1999	12	TANK BARGE	BULK OIL/PRODUCTS	ALLISION	PORT OF MIAMI
1996	9	FREIGHT SHIP		GROUNDING	PORT OF MIAMI

Definitions: Grounding—Contact between a vessel and a submerged object. Collision—Contact between two moving vessels. Allision—Contact between a moving vessel and a stationary object, including another vessel.

68. Environmental Considerations: The proposed navigation improvements for widening mentioned above impact reef and seagrass areas. Mitigation proposals

are under evaluation by resource agencies. The Bill Sadowski Critical Wildlife Area (CWA) located south of the Fisherman's channel has a northern boundary, which may conflict with the proposed widener. The boundary for the northern corner of the Bill Sadowski Critical Wildlife Area (CWA) remains unclear between the Port of Miami and the Florida Fresh Water Fish and Game Commission. According to a consultant for the Port of Miami the coordinates provided in the CWA Establishment Order are flawed. Port of Miami representatives continue to work with FFWCC to resolve the issue.

69. Terrestrial and marine habitats in the vicinity include beaches, mangroves, seagrass beds, hardbottom and reef communities, rock/rubble bottom, and unvegetated bottom. The Biscayne Bay Aquatic Preserve and the Bill Sadowski Critical Wildlife Area are located in the vicinity. Manatees, crocodiles, sea turtles, and many important species of managed fishes and invertebrates utilize Biscayne Bay and offshore habitats. Protection of vital habitats is essential to the survival and maintenance of stocks of these and other fish and wildlife resources.

70. In accordance with the National Environmental Policy Act (NEPA), an information letter was sent to interested parties on January 6, 2000. In addition, all parties were invited to participate in the plan formulation process by identifying any additional concerns on issues, studies needed, alternatives, procedures, and other matters related to the project. A local, state, and Federal resource agency meeting was held on March 13, 2000, to determine the areas of coverage for an environmental baseline resource survey. A meeting followed on November 1, 2000, with those resource agencies to review preliminary results. Appendix A and Appendix B of the Environmental Impact statement include all documents associated with scoping including comments received from various stakeholders during the scoping process.

71. Two related environmental documents that have been generated for other Miami Harbor Expansion projects are the 1989 USACE Navigation Study for Miami Harbor Channel Feasibility Report and Environmental Impact Statement and the 1996 USACE Miami Harbor Channel 10140 General Reevaluation Report (GRR).

PLANNING OBJECTIVES AND CONSTRAINTS

72. The Federal objective, required in water and land resource planning, is to make a contribution toward National Economic Development (NED) consistent with protecting the nation's environment. Planning objectives of this study involved the use of available information to evaluate improvements for Miami Harbor to efficiently and safely accommodate larger vessels while preserving natural and recreational resources impacted by navigation improvements. Specific planning objectives for the General Reevaluation Report for Miami Harbor were to:

- (1) Determine if sufficient light loading, tidal delay, or other commercial navigation benefits exist to deepen the Federal system of channels from existing project depths of 42 and 44 feet to depths of 50 and 52 feet;;
- (2) Evaluate components which would reduce the impact of variable and unpredictable crosscurrents in the area of buoy 1, figure 2, at the beginning of the entrance channel and at the Fisher Island turning basin, figure 3, where three channels converge;
- (3) Examine components to reduce or eliminate the surge effect on ships docked at the Lummus Island terminals from other passing ships in Fisherman's channel;
- (4) Determine if the proposed components meet the needs of future commercial ship navigation requirements;
- (5) Identify environmental and cultural resources in the study area and potential impacts from deepening or widening to those resources;
- (6) Review the impact of proposed components on the existing harbor maintenance and future dredged material management plans; and
- (7) Identify the NED plan for Miami Harbor, which most efficiently and safely accommodates larger vessels while preserving natural and recreational resources.

73. Constraints are restrictions that limit the planning process. Constraints could include resources, legal, or policy constraints. Resource constraints are usually associated with limits on knowledge, expertise, experience, ability, data, information, funding, and time. Legal and policy constraints include those defined by law, Corps policy and guidance. Plan formulation involves meeting the study objectives while not violating constraints. Specific study constraints include:

- (1) Structural constraints: Widening at Fisherman's channel and the radius of the Fisher Island turning basin is constrained to the south by development on Fisher Island. The design engineer on behalf of the resident's of Fisher Island has requested a 50 ft. buffer from the south edge of the Federal channel to the bulkhead, figure 6.
- (2) Environmental constraints: The Fisher Island turning basin is also constrained by seagrasses to the north, figure 3, which will require mitigation if impacted. The Bill Sadowski Critical Wildlife Area (CWA) located south of Fisherman's channel may constrain future channel widening to the south in that area, figures 6 and 7. Reef and seagrass

areas impacted by widening within a proposed project area will require mitigation. A proposed project would minimize or avoid possible adverse effects of the action on seagrasses, fish, and wildlife resources including affects due to potential blasting during construction.

74. The formulation and analysis of alternative plans to achieve planning objectives were based on Water Resources Council's Principles and Guidelines (P&G), the National Environmental Policy Act (NEPA) of 1969, and related Corps regulations. Those guidelines provide for developing alternative resource management systems that address planning objectives.

75. The P&G has a general requirement that all studies formulate and evaluate alternative improvement plans. The aim is to provide a basis for determining the completeness, effectiveness, efficiency and acceptability of the recommended plan. The comparison of NED benefits and costs serves as the basis for determining the efficiencies of the various plans, including the locally preferred plan if it differs from the Federally supportable plan (i.e., the NED plan or granted exception to the NED plan). The cost of the Federally supportable plan is the foundation from which special cost sharing for the locally preferred plan is determined.

76. The NEPA requires analysis, public comment, and reporting for environmental impacts of Federal actions. Title I requires that all Federal agencies prepare detailed environmental impact statements for "every recommendation or report on proposals for legislation and other major Federal action significantly affecting the quality of the human environment". Title II of this statute requires annual reports on environmental quality from the President to the Congress, and establishes a Council on Environmental Quality (CEQ) in the Executive Office of the President with specific duties and functions. The CEQ regulations state "Agencies shall make diligent efforts to involve the public in preparing and implementing their NEPA procedures". NEPA also requires consultation with agencies or technical experts that have participated in the planning process and have provided significant information and recommendations. This coordination is presented in the Environmental Impact Statement that is part of the report.

SHIP SIMULATION TESTING

77. In order to allow larger cruise ships and container vessels the opportunity for safer transits into and out of the Port of Miami, study team members including the Biscayne Bay Pilots, Port of Miami representatives, shipping interests, environmental interests, U.S.C. G. and the U.S. Army Corps of Engineers have proposed a series of improvements to the navigation channels and turning basins at the Port. These improvements are measures or components that provide the basis to form alternatives and are shown in figures 1-10. They are described as follows:

- **Component 1**(figures 1-2): Government Cut serves as the entrance channel for the port. It consists of a series of channel segments identified as Cuts 1 and 2. Proposed project depths for Government Cut range from 44 feet up to 52 feet. A 50-foot project depth represents the maximum depth under consideration for any of the inner harbor channels. An additional two feet for the outer channel allows for vertical motion due to waves. Component 1 widens the seaward portion of Cut 1 from 500 to 800 feet.
- **Component 2** (figure 3): To ease the turn between Government Cut and Fisherman's Channel, a widener on the south side of Government Cut, just inside the jetties, was proposed. The proposed maximum channel depth would be 50 ft.
- **Component 3** (figures 3 and 6): Expand Fisher Island Turning Basin from 1200 ft to 1500 ft. Ships turning to back into Fisherman's Channel or ships docked bow first and backing into the turning basin will use the enlarged turning basin. The proposed turning area will have a maximum depth of 50 feet.
- **Component 4** (figures 4 and 5) : To allow additional cruise ship berths on the north side of the main channel it is proposed to shift the western end of the main channel south. This will allow ships transiting to the main channel turning basin to pass ships docked at the proposed berths. There will be no deepening for this component; depth will remain at 36 feet.
- **Component 5** (figures 6 and 7): Widen Fisherman's Channel 100 ft to the south. This will allow larger beam container ships to pass vessels docked along the Fisherman's Channel piers.
- **Component 6** (figures 7 and 8): Deepen Dodge Island Cut and the proposed 1200 feet turning basin to 36 feet. The western end of Dodge Island Cut will be swung southward to accommodate proposed port expansion.

78. Evaluation of the proposed six improvements proposed for Miami Harbor consisted of a navigation study involving real-time ship simulation modeling . Because of their proximity to the project site, the study was contracted to the Simulation Training Analysis and Research (STAR) Center in Fort Lauderdale, FL. The online testing for the simulation study was conducted during the fall of 2000. Engineering - Appendix B contains a draft report of the ship simulation modeling results.

79. The Port of Miami has also conducted a Passing Ship-Moored Ship Study for Container Ship Berths, draft dated July 2002 (Project Number 172585. This report was prepared by Gee & Jensen, a Division of CH2M Hill, Tampa, Florida). This study evaluated the safe mooring of a Maersk S-Class vessel at container berths 1 and 2 while another S-class transits through Fishermen's Channel. Recommendations for container berth mooring improvements and safe mooring practices are based on an analysis that considers widening Fisherman's channel by 100 feet to the south and a project channel depth of 50 feet. The mooring analysis indicates that the existing configuration of wharf mooring hardware with a limited number of new intermediate mooring points and 10-foot diameter foam-filled fenders provide suitable restraint for the moored ships during passing ship events. The super post-panamax ships are beyond the scope of this study.

ALTERNATIVE PLAN CONSIDERATIONS

80. Alternative plans are different combinations of individual measures or components. Components that generate benefits interdependently are inseparable and must be included collectively in the formulation of alternative plans. Potential transportation cost reduction benefits that are attainable through improvements to the Port are as follows: reduction in the number of tug assists needed for Post-Panamax container vessels, resulting from widening the channel; a decrease in the time spent by vessels while navigating the channel because of the availability of an additional turning basin, resulting from extending the Fisher Island Turning Basin; and, a reduction in, or an elimination of, light loading, resulting from deepening the channel.

Components of Alternatives

81. The following components provide the necessary navigation improvements to achieve cost reduction benefits required to evaluate transportation savings:

- Component 1C (figures 1 and 2) – 1C involves flaring the existing 500-foot wide entrance channel to provide an 800-foot wide entrance at buoy 1. The widener extends from the beginning of the entrance channel about 150 feet parallel to both sides of the existing entrance channel for about 900 feet before tapering back to the existing channel edge over a total distance of about 2000 feet. Deepening of the entrance channel and proposed widener along Cut-1 and Cut-2 from an existing depth of 44 feet in one-foot increments to a depth of 52 feet received consideration.
 - a. Four different versions of Component 1 received consideration during the plan formulation process as shown in figure 2. Receipt of the Baseline Environmental Resource Survey and ship simulation results allowed additional evaluations of the entrance channel alternatives based on the location of environmental resources and ship transits.

- b. Further discussions with the Biscayne Bay Pilots resulted in three additional modifications of component 1 to arrive at 1C, which totally avoids one reef area. 1B avoided both reef areas, but did not provide widening in the area of the variable and unpredictable north and south currents, which have resulted in several ships grounding. Component 1A avoided one reef location, but did not provide sufficient widening in the area where currents impact vessel transits.
- Component 2A (figure 3)– 2A widens the southern intersection of Government Cut with Fisherman’s channel at buoy 15. The length of the widener is about 700 feet with a maximum width of about 75 feet. Depths considered for 2A varied from an existing project depth of 42 feet to 50 feet.
 - a. Two different orientations for the widener received consideration, which included alternatives 2 and 2A. The first recommended by the Biscayne Bay Pilots labeled as alternative 2 in figure 3 extended from the southern edge of Fisherman’s channel parallel to Government Cut between buoys 13 and 15 over a distance of about 2400 feet.
 - b. Ship simulation testing of component 2 indicates the pilots did not use the widener during any of the simulation exercises. Subsequent discussions on May 16, 2001, with the Biscayne Bay Pilots resulted in a reduction of the widener from a length of 2400 feet to 700 feet. During a later review of the revised component 2A at the pilot station, a ship grounded at the location of the proposed widener.
- Component 3B (figure 3) - Component 3B involves extending the existing Fisher Island turning basin to the north. A turning notch of about 1500 feet by 1200 feet extends approximately 300 feet to the north of the existing channel edge near the West End of Cut-3. Depths from 43 to 50 feet at one-foot increments below the existing depth of 42 feet received consideration in the area of the turning notch.
 - a. Component 3 proposed a 1600-foot diameter turning basin. Review of the Baseline Environmental Resource Survey and ship simulation tests resulted in component 3A, which reduced the turning basin to a turning notch of about 1500 by 1450 feet. Since ship simulation testing indicated the pilots did not use the northernmost section of component 3, component 3A resulted. This avoided most of the seagrasses to the north, but still had some impacts.
 - b. Later discussions on May 16, 2001, with the Biscayne Bay Pilots resulted in the pilots’ proposal 3B, which almost completely avoided the seagrass area to the north by truncating the northeast section of the turning basin.

- Component 4 (figures 4 and 5) - Component 4 consists of relocating the west end of the main channel (cruise ship channel or Cut-4) about 250 feet to the south between channel miles 2 and 3 to the existing cruise ship turning basin. No dredging is expected for component four since existing depths allow for continuation of the authorized depth of 36 feet.
- Component 5A (figures 6 and 7)- Component 5A proposes to increase the width of the Lummus Island Cut (Fisherman's Channel) about 100 feet to the south of the existing channel. Deepening proposals examined depths below the existing 42-foot depth at one-foot increments from 43 to 50 feet along the proposed widened channel.
 - a. During the ship simulation exercise, Component 5 provided additional room for vessels passing berthed ships along the container terminals. The pilots used the additional width during almost every proposed condition tested in the Fisherman's Channel.
 - b. Component 5A resulted from the coordination with Fisher Island's engineering representatives to improve clearance between the proposed widener and a proposed new bulkhead in that area.
- Component 6 and 6A (figure 8) - includes deepening of Dodge Island Cut and the proposed 1200-foot turning basin from 32 and 34 feet to 36 feet. It also involves relocating the western end of the Dodge Island Cut to accommodate proposed port expansion.
 - a. During the ship simulation testing a number of ships left the south side of the channel segment between Lummus Island Turning Basin and Dodge Island Turning Basin.
 - b. The USACE Engineering Research and Development Center (Waterway Experimental Station) recommended Component 6 on the condition that the southern edge of that segment is widened 50 feet, which resulted in Component 6A.

Alternative Plan Formulations

82. Alternative plans are different combinations of individual measures or components, figure 1. Components that generate benefits interdependently are inseparable and must be included collectively in the formulation of alternative plans. Nine alternative plans can be formed from the three benefit categories presented:

- Alternative Plan A: No Action Plan

- Alternative Plan B: Widen the Channel (Components 1C, 2A, and 5A)
- Alternative Plan C: Extend the Fisher Island Turning Basin (Component 3B)
- Alternative Plan D: Widen the Channel (Components 1C, 2A, and 5A) and Extend the Fisher Island Turning Basin (Component 3B)
- Alternative Plan E: Deepen the Previously-Authorized Channel Configuration
- Alternative Plan F: Widen the Channel (Components 1C, 2A, and 5A) and Deepen the Resulting Channel Configuration
- Alternative Plan G: Extend the Fisher Island Turning Basin (Component 3B) and Deepen the Resulting Channel Configuration
- Alternative Plan H: Widen the Channel (Components 1C, 2A, and 5A), Extend the Fisher Island Turning Basin (Component 3B), and Deepen the Resulting Channel Configuration.
- Alternative I: Consists of components 6 and 6A.

83. Three categories of potential transportation cost reduction benefits are attainable through improvements to the Port:

- The first benefit category is a reduction in the number of tug assists needed for Post-Panamax container vessels, resulting from widening the channel (Components 1C, 2A, and 5A—these components are inseparable; they all need to be in place in order to accrue this benefit).
- The second benefit category is a decrease in the time spent by vessels while navigating the channel because of the availability of an additional turning basin, resulting from extending the Fisher Island Turning Basin (Component 3B).
- The third benefit category is a reduction in, or an elimination of, light loading, resulting from deepening the channel.

With and Without Project Conditions

84. The alternatives provide engineering solutions to address the problems identified. However, in order to assess the environmental and economic viability of these problems, an evaluation in terms of channel widening, turning basin extension, and deepening was required to assess the with and without project conditions related to improvement features.

Channel Widening

85. Channel widening components comprise widening the seaward portion of the entrance channel from 500 feet to 800 feet (Component 1C – figure 2), dredging the widener between buoys 13 and 15 (Component 2A – figure 3), and widening Fisherman’s Channel approximately 100 feet to the south (Component 5A – figures 6 and 7). The purpose of Channel Widening is to increase safety, reduce damages, reduce delays, and avoid increases in tug assist costs for the

Post-Panamax vessels that are expected to call in the future. Ships have grounded at the entrance channel due to variable and unpredictable currents. Existing conditions allow surging effects that prevent cargo vessels at berth from discharging or loading cargo when a vessel passes.

86. In the without-project condition, as Post-Panamax vessels begin to call, grounding frequency and associated safety reduction and incurred damages will increase. Surging caused by passing vessels will worsen. The Post-Panamax vessels will require extra tug assistance.

87. In the with-project condition, groundings will be significantly reduced. Surging caused by passing vessels will be lessened. Post-Panamax vessels will require less tug assistance. Benefits attributable to channel widening include: (1) reduced damages; (2) reduced delays (vessels holding until grounded vessel is removed and less interruption to discharging vessels); (3) increase in navigation safety; and (4) reduction in tug assist costs.

Fisher Island Turning Basin Extension

88. The existing Fisher Island Turning Basin is not large enough for maneuvering the Post-Panamax container vessels that are expected to call in both the without- and with-project conditions. Without the Fisher Island Turning Basin Extension (Component 3B – figure 3), these vessels can turn in the previously authorized 42' deep Lummus Island Turning Basin, but extending the Fisher Island turning basin would provide a closer place to turn for the larger vessels. Therefore, this increment would provide more flexibility in allocating turning basin use among vessels, leading to timesaving efficiencies.

Fisherman's Channel, Fisher Island Turning Basin, and Lummus Island Turning Basin Deepening

89. Panamax and future-calling Post-Panamax container vessels arriving to or departing from Miami Harbor cannot fully load because of current channel depths. In the without-project condition, this light loading of vessels will sustain current transportation costs. Deepening the channel will allow vessels to more fully load, increasing efficiency. Benefits to deepening are reduced transportation costs resulting from the partial or full elimination of light loading.

ECONOMIC CONSIDERATIONS FOR BENEFIT EVALUTATION

90. National Economic Development (NED) benefits were assessed for all alternatives following the methodology for deep-draft commercial navigation analysis described in the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* and other relevant Corps of Engineers analyses and policy guidance.

91. Proposed channel improvement alternatives that would result in delay reduction benefits include: widening the entrance channel, inner entrance channel between buoys 13 and 15, and the Fisherman's Channel to provide safe navigation for all vessels, particularly post-Panamax containerships; widening the Fisher Island turning basin to improve vessel access and reduce delays; extending the Dodge Island Channel to provide access to planned expanded cruise facilities; and constructing a turning basin at Dodge Island to accommodate the cruise ships using the channel.

92. The benefits of channel widening improvements were estimated in terms of reductions in harbor transit times and consequential vessel delays. Transit times and transportation costs were estimated by analyzing the most likely condition in the absence of an improved channel at Miami Harbor, that is the without project condition, and the proposed channel improvement alternatives for the period 2009-2059. Deepening the channel results in cost efficiencies that accrue, as vessels are able to increase loading and reduce transits.

93. Transit times for navigation of Miami Harbor are largely a function of vessel speed. Variations in vessel speeds are due to vessel size and type and geographic limitations. The larger the vessel, the more difficult it is to maneuver, and therefore, the slower the transit speed. Restricted reaches along the channel also necessitate slower transit speeds. A survey of Miami Harbor's pilots was conducted to elicit information on transit speeds by vessel class for each reach of the Miami Harbor navigation channel. Additionally, the pilots provided information on transit times based on experience by vessel type and destination berth.

94. The key factors in determining the level of benefits derived from proposed improvements are the fleet composition and vessel operating features (cost and underkeel clearance), and cargo growth. Another key factor is the design vessels used in the analysis. The selection of design vessels is not only critical for estimating benefits, but for determining the operational feasibility of the proposed improvements.

Fleet Composition

95. Vessels were divided into classes according to size and use. The vessel classifications describe the attributes of all vessel types that were analyzed. Vessel classifications were standardized for this effort and are summarized in the Economics - Appendix A. The important characteristics of the existing vessel fleet are the dimensions and types of the vessels.

96. Vessel operating costs by vessel class for FY2002 were obtained from the Institute for Water Resources (IWR). The costs represent daily operating costs for U.S. and foreign vessel classes engaged in trade at U.S. deep-draft ports and are specific for vessel flag, type, and size. The costs are published annually by

IWR in an Economics Guidance Memorandum (EGM) and intended for use in Corps' planning studies.

97. The historical minimum underkeel clearance is at least three feet for Panamax container ships. This was determined by analyzing the minimum underkeel clearance used by each vessel as it transited the channel. A sample of historical transit drafts of vessels calling at Miami Harbor was matched with actual tide elevations occurring at the times of transit. Maersk Sealand has a standard of 1.1 meters (3.6 feet) for underkeel clearance for its containerships when they are underway. A review of current practice for the Maersk Sealand Panamax Class (M-class) shows that they use at least three feet of underkeel clearance at the dock. Taking into consideration the Corps of Engineers channel design standard of three feet of underkeel clearance for hard bottom channels, the current actual practice of using at least three feet of underkeel clearance at the dock, and the Maersk Sealand standard of 3.6 feet of underkeel clearance while underway, three feet of underkeel clearance was used for the economic analysis for the large container ships. It should be noted that through a partnering agreement other shipping companies ship their containers on the Maersk Sealand vessels. So, with respect to Maersk Sealand vessels, the Maersk Sealand M-class and S-class container ships are considered generic; that is, they represent similar size container ships owned by other shipping companies.

Commodity Growth

98. Historically, cargo growth has varied by trade region and by direction (origin/destination). It is expected that cargo will continue to grow in a similar pattern in the future; that is, the future will reflect, in part, the past, as no significant changes in the pattern of cargo traffic are anticipated without or with the project.

99. Container and trailer cargo represents 97.4 percent of all cargo. The remaining 2.6 percent consists of neobulk and breakbulk cargo. Because neobulk cargo and breakbulk cargo represent such a small portion of the overall cargo handled at the Port of Miami, they have an insignificant impact on current and future cargo and vessel traffic at the Port. Accordingly, for the analysis, neobulk cargo and breakbulk cargo are not analyzed separately, but are accounted for by including them in containerized cargo. Specifically, tonnage associated with these cargo types is accounted for in the projected future. This is a reasonable simplification as more and more neobulk and breakbulk cargos are being shipped in containers.

100. Details of the commodity tonnage can be found in the Economics - Appendix A. **Table 6** displays the summary of actual and projected short tons by the trade regions of Latin America and Caribbean, Asian Far East, Europe, Middle East, and North America. The projected total short tons are displayed by

trade region to include study year through base year 2009, and 5 year increments. Using the previously described procedure for estimating the average annual rate of change in cargo tonnage from 2002 (last full year of actual recorded tonnage) to the end of the study period (2059) resulted in the following the average annual rates of growth by trade region: Latin America and Caribbean, 4.46%; Asian Far East, 5.29%, Europe, 5.30%, Middle East, 1.00%, North America, 2.94%, and an overall rate of 4.75%.

Table 6 - Summary of Actual and Projected Short Tons by Trade Region

Year	Latin America & Caribbean Total Short Tons	Far East (Asian) Total Short Tons	Europe Total Short Tons	Middle East Total Short Tons	North America Total Short Tons	All Regions Total Short Tons
2000	4,693,539	887,509	1,858,625	44,882	320,391	7,804,946
2001	5,072,892	954,163	1,817,706	62,981	339,262	8,247,004
2002	5,281,079	1,082,402	1,944,306	190,899	183,049	8,681,735
2003	5,601,144	1,159,296	2,080,549	193,243	190,371	9,224,603
2004	5,940,609	1,241,712	2,226,607	195,630	197,986	9,802,544
2005	6,300,651	1,330,050	2,383,201	198,058	205,905	10,417,865
2006	6,682,516	1,424,739	2,551,105	200,530	214,141	11,073,031
2007	7,087,528	1,526,242	2,731,151	203,046	222,707	11,770,674
2008	7,517,091	1,635,051	2,924,233	205,607	231,615	12,513,597
Base yr. --2009	7,972,692	1,751,700	3,131,311	208,213	240,880	13,304,796
Year 5 -- 2014	10,699,997	2,473,992	4,415,584	221,957	293,067	18,104,597
Year 10 -- 2019	14,360,414	3,498,005	6,242,024	236,969	356,561	24,693,973
Year 15 -- 2024	19,273,249	4,951,187	8,843,788	253,365	433,811	33,755,400
Year 20 -- 2029	25,867,089	7,015,329	12,555,454	271,273	527,798	46,236,943
Year 25 -- 2034	30,032,104	8,379,479	15,017,511	280,881	582,731	54,292,706
Year 30 -- 2039	34,867,852	10,011,494	17,970,580	290,923	643,382	63,784,231
Year 35 --2044	40,482,364	11,964,410	21,513,637	301,421	710,346	74,972,178
Year 40 --2049	47,001,073	14,301,835	25,765,744	312,394	784,280	88,165,326
Year 45 -- 2054	54,569,619	17,100,070	30,870,137	323,864	865,908	103,729,598
Year 50 --2059	63,357,103	20,450,658	36,999,156	335,854	956,033	122,098,804

1/ 2002 is latest complete fiscal year of reported cargo from port records.

101. Projection of tonnage based on two commodity classes (container and Ro/Ro-General Cargo) are shown in **Table 7**, along with projected cruise ship passengers. The annual growth rates used for the 50-year study period (2009 to 2059) are as follows: containers, 4.53 percent. Ro-Ro cargo (i.e., trailer cargo that is containerized cargo that is carried on RO/RO's), 4.53 percent; and passengers, 2.00 percent for the period 2009 to 2059. It is assumed for this analysis that the compound annual growth rate for cruise ship passengers will be 2 percent, the same as the historical compound annual growth rate for the 10-

year period, 1990 to 2000. These growth rates are assumed to occur without or with any harbor improvements.

Table 7 - Forecast Tonnage by Commodity Class

Forecast Commodity Tonnage Without Project/ With Project Conditions						
	2009	2019	2029	2039	2049	2059
Containers	8,515,069	15,804,143	29,591,644	40,901,872	56,534,985	78,143,234
Ro-Ro, Lo-Lo	4,789,727	8,889,830	16,645,300	23,007,303	31,800,929	43,955,569
Total	13,304,796	24,693,973	46,236,944	63,909,176	88,335,915	122,098,803
Cruise Passengers	4,101,481	4,999,683	6,094,585	7,429,265	9,056,233	11,039,497

102. Given forecast commodity traffic, future vessels calls were estimated based on forecast vessel calls at the port under the without project condition and the proposed channel improvement alternatives. The future fleet includes the addition of the SUSAN MAERSK and other Post-Panamax containerships, as well as the continued arrivals of mega-cruise ships. The forecasted vessel trips that were used to estimate delay reduction benefits are displayed in **Table 8**. It is important to note that the forecast future vessels calls are identical in the with- and without project conditions (without deepening).

Table 8 - Forecast Vessel Trips

Forecast Vessel Trips Without/ With Project Conditions						
Commodity	2009	2019	2029	2039	2049	2059
Containers	1,214	1,364	1,657	2,073	2,578	3,295
Ro-Ro, Lo-Lo	1,302	1,409	1,646	1,982	2,212	2,565
Cruise	1,172	1,219	1,270	1,351	1,509	1,673
Total	3,688	3,992	4,573	5,405	6,300	7,532

Design Vessel

103. A design vessel represents the largest vessel class that is expected to call over the study period of analysis. It is important to identify the design vessel(s) so that decision makers can be reasonably confident that the significant study and project costs will result in a channel design that will accommodate vessel traffic for the foreseeable future at Miami Harbor. As Miami Harbor is considered a “clean port”; (i.e., it does not handle bulk cargoes or potentially dangerous or hazardous cargoes such as fuel oil). Accordingly, only two types of vessels need to be considered: container ships and passenger (cruise) ships.

104. The District was advised by Maersk that the largest container ships that it would use at the Port of Miami in the near-term future are its 6,600-TEU S-Class container ships that are 1,138.4 feet long with an extreme breadth 140.8 feet and a design draft of 47.6 feet. There are 37 6,000+ TEU Post-Panamax container ships in the world fleet (Lloyd’s Register of Ships, April 2001). Of the 37, Maersk owns and operates 21 S-Class vessels in its fleet, which are currently deployed in the Europe-Far East trade and the Far East-U.S. West Coast trade. The Maersk Sealand’s SUSAN MAERSK was selected for the design vessel for the economic analysis.

105. Because of the growth in cruises, channel improvements, as well as a Dodge Island turning basin, are being considered for the Dodge Island Terminal Number 12 (south western side of Dodge Island). Since November 2001, Celebrity Cruise Lines’ HORIZON has utilized this terminal. The HORIZON is 682 feet long, with a beam of 96 feet, and a draft of 24 feet. Based on discussions with the Port, the CARNIVAL DESTINY was selected as the design vessel for this project alternative. The CARNIVAL DESTINY is 893.5 feet long, with a beam of 116, and a draft of 27 feet.

106. Lloyd’s Register of Ships was also reviewed for the selection of a cruise ship design vessel. Based on the review, the Royal Caribbean International’s VOYAGER OF THE SEAS was selected as the design vessel for the study. It is 137,300 GRT, is 1,021 feet long, and has a beam of 156 feet and a design draft of 28.2 feet. This cruise ship, which is currently calling, is considered the largest cruise ship likely to call at Miami Harbor for the foreseeable future. Presently, Royal Caribbean International has two VOYAGER-class ships calling a Miami Harbor: the VOYAGER OF THE SEAS and the EXPLORER OF THE SEAS. The draft requirement of the design vessel does not present a problem as the Main Channel has a project depth of 36 feet. Modern cruise ships are designed with drafts that can be accommodated by the shallow depths at their ports-of-call. However, the QUEEN MARY II, which is scheduled for completion in 2003, will be 1,131 feet long with a beam of 131 feet and a design draft of 32.8 feet. Thus, the QUEEN MARY II is 110 feet longer than the VOYAGER OF THE SEAS, but its beam is 25 feet less. Because it is longer, and could potentially call, the

SUSAN MAERSK container ship with a length of 1,138 feet and a beam of 141 feet was turned in the Main Channel Cruise Ship Turning Basin during the ship simulation. There were no problems with turning the large container ship.

BENEFIT SUMMARY

107. The benefit methodology considers historical, present, and expected, future trends in vessel fleet composition, vessel itineraries, and trade routes that impact the Port of Miami. Given that so many Post-Panamax container ships are being built, it is assumed that Post-Panamax container ships will be deployed on the East-West Atlantic trade route, with calls at U.S. East-Coast ports, before the base year (2009) of the Miami Harbor project. It is also assumed that the itineraries will include calls at Miami Harbor. Accordingly, it is assumed for this analysis that the Panamax container ships currently calling at Miami Harbor as part of the European, Mediterranean, and Asian trade will be gradually replaced by Post-Panamax container ships over the study period beginning prior to the base year (2009) of the study.

108. The only thing that is physically preventing the deployment of Post-Panamax container ships at Miami Harbor is an adequate size turning basin. The Lummus Island Turning Basin has been authorized, funded, and will be constructed prior to the base year. The 1500 foot diameter turning basin will be sufficient for turning the Post-Panamax container ship design vessel SUSAN MAERSK. The Ship Simulation verified this. Thus, it is assumed that Post-Panamax container ships will call in the without-project condition, prior to the base year. The depth of the Lummus Island Turning Basin will be commensurate with the existing project channel depth, 42 feet.

Streams of Benefits and Costs

109. The bulk of a project estimated cost is generally incurred during the construction period. Benefits on the other hand, typically are realized as uneven flows of income or monetary benefits that accrue over a long period of time. The time frame period of analysis is 50 years. Decision criteria must provide a means of comparing the values of these streams of money on an equal basis.

110. It is recognized that a dollar today is worth more than a dollar in the future. To account for these differences in the time value of money, monetary values are "discounted", i.e., amounts of money realized in the future are expressed as equivalent amounts of money today tied in to a discount rate at a given price level. Planners are directed to use price levels prevailing during the planning period, i.e., fixed to a month and year. The discount rate formula has been prescribed by Section 80 of the Water Resources Development Act of 1974. It is published annually by the Headquarters of the U.S. Army Corps of Engineers on a fiscal year basis. The discount rate in affect for FY 2003 is 5 7/8%

Channel Widening Analysis

111. The first increment examined is channel widening. These are components 1C, 2A, and 5A, of figure 1 which comprise Alternative B. However, with the inclusion of Post-Panamax vessels in the fleet, a second increment of extending the Fisher Island turning basin, Component 3B of figure 1 is considered. Component 3B alone is called Alternative C. The combination of Alternative B and C formulates Alternative D (channel widening components 1C, 2A, and 5A along with component 3B, Fisher Island turning basin extension). Adjustments were made to each alternative to incorporate the following assumptions:

- 1) Widening entrance channel, buoys 13-15, figure 3, and Fisherman's channel – In the absence of improvements in Miami Harbor, the *Susan Maersk* (S-Class) and similarly-sized Post- Panamax vessels, would need to lightload and transit the channel with the assistance of 3 tugs at a dead-slow speed. The transit would be 30 minutes slower than normal. The container fleet distribution would change over time, eventually composed entirely of Panamax and Post-Panamax vessels in the Far East, European and Mediterranean trades. With improvements, the container vessels would continue to lightload and require the assistance of two tugs, but could transit the channel at a more normal speed. The incremental savings, which represents vessel delay reduction benefits, are the foregone costs of the third tug assist and reduced transit time (input from Biscayne Bay pilots and Coastal Tug and Barge).
- 2) Widening Fisher Island Turning Basin (figure 3) - In the absence of improvements, Post-Panamax vessels calling at Miami are constrained to use of the Lummus Island turning basin (figure 7) only, resulting in additional transit time and delays for vessels berthing closest to the Fisherman's Channel entrance. With improvements, vessels have the option of turning before or after berthing. Pilots will have more flexibility to manage traffic and minimize delays within Miami Harbor. The incremental savings, which represent vessel delay reduction benefits, are the reduced transit times and delays for vessels transiting and berthing on Fisherman's channel.
- 3) Constructing Dodge Island Turning Basin (figure 8)- In the absence of improvements, cruise ships on the south pier would use the Lummus Island turning basin for maneuvering. Given the priority of cruise ships in Miami Harbor, such use would interfere with commercial cargo operations and result in delays for cargo vessels. With improvements, the cruise ships would have an exclusive

turning basin. The incremental savings, which represent vessel delay reduction benefits, are the foregone interference and delay costs for cargo vessels transiting Fisherman's channel. The interference costs take into account the cruise ships schedule and probability of being delayed.

112. In analyzing the benefits of the Dodge Island Channel extension, a different technique was used. According to guidance developed by IWR, benefits associated with cruise ships from harbor improvements could accrue from three sources: 1) existing vessels using a harbor under without-project conditions operate more efficiently in that same harbor under with-project conditions; 2) vessels using one harbor under without-project conditions transfer to the improved harbor under with-project conditions; and 3) new vessels (larger, with more amenities) begin using a harbor under with-project conditions that they did not use under without-project conditions. Benefits could accrue to both vessel operators and passengers under each of the three scenarios.

113. In the absence of improvements, the cruise ship *Horizon* would represent the maximum-sized/capacity vessel that could operate on the south pier. The vessel LOA is 727 feet and its passenger capacity is 1,354. With improvements, a larger vessel could operate in place of the *Horizon*. The design vessel is the *Destiny*, which has an LOA of 893 feet and a passenger capacity of 2,642. Given an identical itinerary, the *Destiny* could accommodate nearly twice the number of passengers per trip. While additional passengers and a larger vessel result in higher costs per voyage, the opportunity to use the larger vessel on the same itinerary will result in increased income. The incremental benefits are the net incomes that accrue from the additional passengers. The annual reports of the major cruise lines were referenced to calculate a representative net income per passenger estimate. Over time, as the demand for cruises increases, additional vessels would be expected to berth on the south pier.

114. Incremental savings, by decade, for each of the channel improvement alternatives are presented in **Table 9**. Each of the alternatives result in significant transportation cost reductions over the without project condition. The Channel Widening results in average annual savings ranging from about \$ 0.3 million in 2009 to about \$ 15.6 million in 2059. While the entrance channel widening provides safe navigation for the SUSAN MAERSK and other Post-Panamax vessels, another advantage of the widened channel is that it allows smaller vessels (maximum 80' beam) to pass in the channel. These vessels make up a significant proportion of traffic at Miami Harbor. Given that cruise ships do not experience delays because of priority berthing and pilotage, no delay reduction savings were claimed for any of their vessel classes.

Table 9 - Annual Transportation Costs Savings
(\$ 000)

Alternative	2009	2019	2029	2039	2049	2059
Without Project Condition	--	--	--	--	--	--
Widening (Ent. Chan; Buoys 13-15; Fisherman's Channel	\$341	\$1,237	\$3,420	\$5,072	\$9,007	\$15,565
Fisher Island Turning Basin Widening	\$216	\$553	\$1,416	\$2,400	\$4,130	\$7,239
Dodge Island Channel Extension	\$529	\$1,058	\$2,115	\$2,115	\$2,115	\$2,115
Dodge Island Turning Basin Construction	\$519	\$650	\$773	\$943	\$1,123	\$1,339

115. Cost reduction benefits for the proposed channel improvement increments of entrance channel widening, Fisher Island turning basin widening, Dodge Island channel extension, and Dodge Island turning basin construction for Miami Harbor are summarized in **Table 10**. The benefits reflect an interest rate of 5 7/8 percent and October 2002 price levels .

Table 10 - Miami Harbor Benefits Summary for Channel Widening

Alternatives	Total Present Worth (\$000)	Average Annual Benefits (\$000)
Without Project Condition	--	--
Widening (Entrance channel, buoys 13-15, Fisherman's Channel)	\$41,401	\$2,581
Fisher Island Turning Basin Widening	\$18,883	\$1,174
Dodge Island Channel Extension	\$21,123	\$1,317
Dodge Island Turning Basin Construction	\$11,420	\$712

116. The Average Annual Equivalent (AAEQ) transportation benefit for widening the entrance channel at buoys 13 and 15, and Fishermans channel is \$2,581,000. The first cost of this feature is \$17,935,000 for an AAEQ cost of \$1,118,000. The net benefit of this feature is \$1,463,000. This widening is necessary prior to the accruing benefits to the Fisher Island Turning Basin and channel deepening. This finding eliminates four of the alternative plans, leaving Alternative Plans B, D, F, and H.

117. The second increment examined is extending the Fisher Island Turning Basin, Component 3B. The incremental AAEQ benefit realized from adding this component is \$1,174,000. The incremental first cost is \$5,574,000. The incremental AAEQ cost is \$347,000. The incremental AAEQ benefit is \$827,000. As this increment shows that the marginal benefit exceeds the marginal cost this finding eliminates two of the remaining alternatives, leaving Alternative Plans D, H, and I.

118. For Alternative Plan I, comprising the extension of the Dodge Island Channel and the construction of the Dodge Island Turning Basin the components

were found to be unfeasible following a preliminary benefit/cost analysis. Therefore, they were not included in the final set of Alternative Plans

Vessel Utilization Savings (Deepening Benefits)

119. The final set of increments examined is deepening the newly configured channel from 43 to 50 feet. Transportation costs for the without and with-project conditions were estimated in one-foot increments to compute the National Economic Development (NED) benefits associated with the project deepening. The difference between the without- and with-project costs represents the benefits of the deepened channel. Cost efficiencies accrue, as vessels are able to increase loading and reduce transits. A detailed description of the methodology, assumptions and parameters employed is found in Vessel Utilization Savings (Deepening Benefits) section of the Economics - Appendix A.

120. As previously discussed in ECONOMIC CONSIDERATIONS FOR BENEFIT EVALUATION, total transportation costs are estimated using the specifications of each vessel (average deadweight, length overall, beam, design draft, speed, and so forth) along with estimated vessel transit characteristics, transit mileage, and vessel hourly operating cost data developed by the Corps' Institute for Water Resources (IWR).

121. Vessels currently calling that could benefit from a deeper channel at Miami Harbor are the Panamax Class vessels represented by the Maersk Sealand M-class container ships; vessels expected to call in the future that could benefit are Post-Panamax container ships, like the design container ship, SUSAN MAERSK, a Maersk Sealand S-class vessel. The analysis assumes that as the Post Panamax vessels begin to call at Miami Harbor, they will gradually replace smaller Sub Panamax vessels; in later years of the project, they will gradually replace some of the Panamax vessels. The analysis focused on these vessel classes and their proportion of the total cargo handled by the Port.

122. The analysis predicted a gradual transition to larger vessels for the life of the project. The assumed distribution of calls for each year of the project was a function of the distribution of calls that actually occurred in 1999. Post-Panamax vessels replace smaller vessels, that is, Sub-Panamax class container ships. This replacement increases in a straight-line fashion until in the later years of the 50-year study period the fleet consists of only Panamax and Post-Panamax container ships in the Far East, European and Mediterranean trades. **Table 11** displays the percentage of export and import tonnages for these trade regions.

Table 11: Percentage of Tonnage by Trade Region at Miami Harbor

Trade Region	2002 Import Tonnage	Trade Region Share of Import Tonnage	2002 Export Tonnage	Trade Region Share of Export Tonnage	2002 Total Tonnage	Trade Region Share of Total Tonnage
Far East	746,862	31%	335,540	43%	1,082,402	34%
Europe	1,549,637	64%	394,669	50%	1,944,306	60%
Mediterranean	131,713	5%	59,186	7%	190,899	6%
Total	2,428,212	100%	789,395	100%	3,217,607	100%

123. The Economics - Appendix A provides a detailed description of transportation costs without and with the project in one-foot deepening increments. The difference between transportation costs in the without- and with-project conditions equals the project deepening benefits. These detailed calculations are summarized in **Table 12**, which displays both total discounted benefits and their average annual equivalent (AAEQ).

Table 12 - Total Discounted and Average Annual Equivalent Benefits for Each Potential Project Depth at Miami Harbor

Channel Depth (ft.)	Total Discounted Benefits	AAEQ Benefits	Incremental AAEQ Benefits
43	\$36,202,373	\$2,256,856	\$2,256,856
44	\$69,425,204	\$4,327,968	\$2,071,112
45	\$100,041,464	\$6,236,586	\$1,908,618
46	\$123,375,444	\$7,691,226	\$1,454,640
47	\$142,293,763	\$8,870,595	\$1,179,369
48	\$160,238,003	\$9,989,239	\$1,118,644
49	\$176,794,867	\$11,021,394	\$1,032,155
50	\$177,616,802	\$11,072,633	\$51,239

QUANTITIES ESTIMATE

124. The quantities for the plan components included project depths from 42 to 50 feet. The components for the quantities are defined as follows:

- a. Component 1C – Cuts 1 and 2: Quantities for the entrance channel include 45 – 52-foot required depths with a one-foot allowable overdepth. Examination of widening depths started with the existing project at 44 feet plus one-foot allowable overdepth.
- b. Component 2A – Cut 3 new widener. Quantities for the channel depths include 43 – 50-foot required depths with a one-foot allowable depth. Examination of widening depths started with the existing project at 42 feet plus one-foot allowable overdepth.

- c. Component 3B – Cut 3, Fisher Island turning basin. Quantities for the channel depths include 43 – 50-foot required depths with a one-foot allowable overdepth. Examination of widening depths started with the existing project at 42 feet plus one-foot allowable overdepth.
- d. Component 5A – Fisherman’s Channel and Lummus Island Turning Basin. Quantities for channel depths include 43 - 50 foot required depths with a one-foot allowable overdepth and include designated port berthing areas adjacent to Fisherman’s Channel at required depth plus one-foot for allowable overdepth. Examination of widening depths started with the existing project at 42 feet plus one-foot allowable overdepth.

125. **Table 13** displays a summary of the estimated quantities for each considered depth, as found in the MCACES estimate in Engineering - Appendix A. It also displays the quantities required for the utility relocations of the water line and sewer main.

Table 13 - Dredging Quantities

	Depth Alternative (ft.)								
	<u>42</u>	<u>43</u>	<u>44</u>	<u>45</u>	<u>46</u>	<u>47</u>	<u>48</u>	<u>49</u>	<u>50</u>
Mechanical Dredging (cy)									
Comp. 2A - Cut 3 Widener	4,764	5,383	6,155	7,063	7,976	8,889	9,802	10,715	11,628
Comp. 3B - Cut 3	63,886	75,535	103,567	188,278	252,615	382,485	460,595	538,705	616,816
Comp. 5A, Fisherman Channel	298,002	360,945	428,996	524,311	625,191	726,604	828,015	929,428	1,034,940
Comp. 5A – Port Berths	--	23,620	62,014	91,916	124,428	154,548	191,581	228,617	254,725
Comp. 5A - Lummus Island Turning Basin	<u>87,257</u>	<u>127,493</u>	<u>167,101</u>	<u>206,430</u>	<u>245,743</u>	<u>285,080</u>	<u>324,417</u>	<u>420,228</u>	<u>516,036</u>
Total for Mechanical Dredging	453,909	592,976	767,833	1,017,998	1,255,953	1,557,606	1,814,410	2,127,693	2,434,145
Pipeline Dredging (cy)									
Component 1C - Cut 1 & 2	17,541	24,366	84,961	120,111	219,836	324,888	430,499	536,700	643,358
Point of Intersection Wideners									
Component 1C - Cut 1	--	16,953	74,943	180,387	325,402	472,119	620,071	768,704	1,068,412
Component 1C - Cut 2	--	5,798	57,497	103,578	188,364	277,107	365,997	454,888	543,779
Component 3B, Cut 3	95,831	113,303	155,351	185,062	249,399	249,627	301,701	353,775	405,848
Comp. 5A, Fisherman Channel	250,000	250,000	250,000	250,000	250,000	250,000	250,000	250,000	250,000
Comp. 5A - Lummus Isl. Turning Basin	--	--	--	--	--	--	--	--	--
Comp. 5A - Port Berths	--	15,314	30,560	36,018	40,114	47,036	47,036	47,036	47,036
Comp. 5A, Lummus Island Turning Basin	<u>6,818</u>	<u>61,922</u>	<u>117,963</u>	<u>174,378</u>	<u>230,844</u>	<u>287,317</u>	<u>343,791</u>	<u>343,791</u>	<u>343,791</u>
Total for Pipeline Dredging	370,190	487,656	771,275	1,049,534	1,503,959	1,908,094	2,359,095	2,754,894	3,302,224

Utility Relocation (cy)**Trench excavation 20" --**

Water Line	--	31,607	35,311	39,015	42,719	46,422	50,126	53,830	57,533
Backfill trench	--	27,904	27,904	27,904	27,904	27,904	27,904	27,904	27,904

Trench excavation 54" --

Sewer Line	--	33,704	37,407	41,111	44,815	48,519	52,222	55,926	59,630
Backfill trench	--	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000

Total Quantities (cy) 824,099 1,203,847 1,669,730 2,205,562 2,905,350 3,618,545 4,333,757 5,050,247 5,911,436

* Each depth contains an additional two-foot wave allowance for the entrance channel Cuts 1 and 2.

GEOTECHNICAL INVESTIGATIONS

126. The majority of the material to be removed is rock that is moderately hard to very hard and will require blasting. While a portion of the materials in Miami Harbor can potentially be excavated using a heavy-duty rock cutterhead dredge and/or excavator, past dredging events have shown that both have experienced great difficulty in removing the rock. The matrix of the rock, with the addition of solution activity and recrystallization, exhibits zones of differential rock strength that cause the rock to fragment into large pieces that makes excavation very difficult, as seen in past dredging activities. Due to previous dredging episodes, gravel, cobbles and boulders are expected to be located throughout the project. In many areas, throughout the project, material has been removed well below the existing project depth.

127. Geotechnical analysis has identified areas from Cut 1, Sta. 0+00 to 90+00 and Cut 2, Sta. 13+00 to Cut 3, Sta. 5+00, where moderately hard to hard rock is present but fractured and exhibits frequent layers of weaker rock or sand. This rock is primarily moderately hard calcareous sandstone and sandy limestone with areas of sand present. Rock similar to this was previously dredged in Phase I of the deepening in the same area using a large cutterhead dredge. Based on existing Geotechnical data, this area exhibits potential for deepening with minimum or no blasting based on proposed equipment use. Additional core borings are required to further define the rock quality in this area and throughout the project.

INITIAL FIRST COST OF CONSTRUCTION FOR ALTERNATIVES

128. The engineering analysis considered alternative plans for widening at the existing 42-foot project depth and widening and deepening for proposed depths in one foot increment to a depth of 50 feet mean lower low water. As previously noted the entrance channel has an additional two-foot wave allowance. The MCACES estimate in Engineering - Appendix A contains a detail breakdown of initial first costs for the National Economic Development (NED) and Locally

Preferred (LP) plans. The cost presented include the post-construction monitoring costs of \$150,000 (over 3 years) and annual maintenance cost for navigation aids of \$15,000. **Table 14** (reference Table A-85 in Economics – Appendix A) summarizes the total first costs as derived from the MCACES and estimated duration:

Table 14 - First Cost Summary for Depth Alternatives

Alternative depth (channel and entrance channel)	First Cost (October 2002 price level)	Estimated MCACES duration (months)
42 ft. and 44 feet	\$28,741,263	26
43 feet and 45 feet	\$88,548,435	33
44 feet and 46 feet	\$101,978,033	38
45 feet and 47 feet	\$112,980,954	42
46 feet and 48 feet	\$126,574,108	45
47 feet and 49 feet	\$140,461,519	49
48 feet and 50 feet	\$151,140,812	52
49 feet and 51 feet	\$162,304,536	55
50 feet and 52 feet	\$172,713,785	58

129. The estimated costs as computed in the MCACES (as per Engineering - Appendix A) are based on historic contractor rates for similar work. A 20 percent contingency on the estimated construction costs is used, as appropriate for this level of project design. Planning, Engineering, and Design (PED) and Supervision and Administration (S&A) costs are also included. Associated costs for port bulkheads were provided by the Miami Port Authority. Monitoring for preconstruction and during construction were based on cost requirements for the mitigation area. Real Estate costs include administrative costs for certification of lands as available under navigational servitude for all dredging work including relocations and placement of material in the upland confined disposal facility on Virginia Key, the offshore Ocean Dredged Material Disposal Site, offshore artificial reef sites, and northern Biscayne Bay borrow sites. No known acquisition of lands is required at this time. Real Estate - Appendix C also contains a description of the administrative costs.

130. The Miami-Dade Water and Sewer Department (WASD) owns a 54-inch concrete force sewer main with a top elevation of 50 mlw, crossing Government Cut-2 and a 20-inch ductile iron water main with a top elevation of 53 mlw, crossing Fisherman Channel as per WASD as-builts. To allow for adequate minimum coverage over utility removal of these utilities relocation will occur at the proposed depth of 43 feet. Therefore, this relocation cost is included for all of the alternatives.

131. Post construction cost items are for monitoring of the reef mitigation areas for a period of three years. Aids to navigation costs are also a post construction item for the period of the authorized project.

INTEREST DURING CONSTRUCTION

132. Interest During Construction (IDC) accounts for the opportunity cost of expended funds before the benefits of the project are available and is included among the economic costs that comprise NED project costs. The amount of the pre-base year cost equivalent adjustments depends on the interest rate, the construction schedule, which determines the point in time at which costs occur, and the magnitude of the costs to be adjusted. Preconstruction, Engineering and Design (PED) costs are included in the IDC as well as construction costs.

133. **Table 15** (references Tables A-88 and A-89 of Economics Appendix-A) displays the IDC estimated for the project feature for the total first cost associated with each of these features. The AAEQ for the IDC and the total cost and IDC is also displayed. The AAEQ for Environmental Monitoring of \$8,351 (cost of \$50,000 per year for first three years, amortized for 50 years at the 5 7/8% discount rate) is the same for all plan alternatives. All these plans also have an additional annual cost of \$15,000 attributed to aids to navigation.

Table 15 - Interest During Construction

Project	Total First Costs	AAEQ for Total First Cost	IDC	AAEQ IDC	Total First Costs and IDC	AAEQ Total First Costs and IDC
1C Widen Entrance Channel, 2A Widener between Buoys 13 and 15, 5A Widen Fishermans Channel	\$22,150,879	\$1,380,886	\$1,060,710	\$66,125	\$23,211,589	\$1,447,011
3B Extend Fisher Island Turning Basin	\$28,576,260	\$1,781,444	\$1,738,500	\$108,378	\$30,314,760	\$1,889,822
Deepen to 43 Feet	\$88,383,432	\$5,509,824	\$6,385,233	\$398,055	\$94,768,665	\$5,907,880
Deepen to 44 Feet	\$101,813,031	\$6,347,025	\$9,095,997	\$567,045	\$110,909,028	\$6,914,070
Deepen to 45 Feet	\$112,815,951	\$7,032,948	\$10,975,172	\$684,192	\$123,791,122	\$7,717,140
Deepen to 46 Feet	\$126,409,104	\$7,880,345	\$13,353,612	\$832,464	\$139,762,716	\$8,712,809
Deepen to 47 Feet	\$140,296,515	\$8,746,086	\$15,784,941	\$984,033	\$156,081,455	\$9,730,120
Deepen to 48 Feet	\$150,975,807	\$9,411,833	\$17,759,143	\$1,107,105	\$168,734,950	\$10,518,939
Deepen to 49 Feet	\$162,139,530	\$10,107,780	\$21,078,047	\$1,314,006	\$183,217,578	\$11,421,786
Deepen to 50 Feet	\$172,548,780	\$10,756,693	\$24,376,547	\$1,519,634	\$196,925,328	\$12,276,327

NED PLAN SELECTION

134. The final set of increments examined is deepening the newly configured channel from 43 to 50 feet. Since utility relocation is a project implementation cost that will be incurred with all the proposed deepening alternatives, a benefit can be claimed when the utility relocation involves replacement.

ADVANCED UTILITY REPLACEMENT BENEFIT

135. If a railroad, highway, street, or utility is replaced as a result of a federal project, a benefit can be claimed to at least partially offset the cost of the replacement. An advanced utility replacement benefit can be taken for the useful life that the utility is extended by the project. For example, the useful life of the water main has been estimated to be about 50 years from the date of its original placement. The water main will be twenty years old at the base year (2008), with a useful remaining life of about 30 years. By replacing this utility as a result of a proposed federal project, with one that also has an estimated life of 50 years, the life of the utility has been extended by twenty years (50 years minus the remaining useful life of the existing utility). The cost of the relocation varies by the cubic yards of trench excavation.

136. **Tables 16** and **17** display the a sample benefit calculation for the water line, and forced sewer main, respectively for the greatest depth alternative, the 50 ft. depth, using the MCACES cost estimate at an October 2002 price level, and a federal discount rate of $5 \frac{7}{8}$ percent. The AAEQ benefit total for both of these utilities ranges from about \$62,000 for the 43 ft. depth to about \$90,000 for the sum of the two utilities for the 50 ft. depth as show in these two tables.

**Table 16 - Advanced Utility Replacement Calculation for 50 ft. depth
alternative – Water Line**

		<u>feature</u>	<u>cost</u>
Utility:	Water Line	mob and demob	\$102,729
Year built :	1988	trench excavation	2,346,274
Base year of project:	2008	pipeline installation	250,364
Age of utility at base year:	20 years	backfill trench	436,915
Estimated remaining life	30 years	test and inspect new line	1,665
Elevation: -53.0 ft.		clean and abandon old line	<u>6,795</u>
			\$3,144,742

Utility: Water Line

Cost of new UTILITY		\$3,144,742
Life of new UTILITY		50 yrs.
Remaining useful life of existing UTILITY		30 yrs.
Extension of UTILITY life	(#2-#3)	20 yrs.
Annual O&M of existing UTILITY		\$0
Annual O&M of new UTILITY		\$0
Interest rate		5.875%
Capital recovery factor (for 50 years)	CRF (i =.05875, n=50)	0.06234
Annual cost of new UTILITY	(#1*#8)	\$196,043
Present worth of annuity factor for		
extension of UTILITY life (#4 years)	(uniform series present worth)	11.58723
Benefits in year #3, credited to UTILITY life		
extension	(#9*#10)	\$2,271,597
Single payment present worth factor for yrs. in #3		0.18038
Present worth in year 1 of UTILITY		
extension	(#11*#12)	\$409,800
Annual O&M savings	(#5-#6)	\$0
Present worth of annuity factor for	#3 years (uniform series present worth)	13.95092
Present worth in year 1 of O&M savings (#14*#15)		\$0
Present worth of total credit (#13+16)		\$409,800
		-
Average annual credit (benefit) (#17*#8)		\$25,547
		-

**Table 17 - Advanced Utility Replacement Calculation for 50 ft. depth
alternative – Sewer Main**

Utility: Forced Sewer Main			
Year built :	1976	mob and demob	\$102,729
Base year of project:	2008	trench excavation	\$2,428,494
Age of utility at base year:	32 yrs.	pipeline installation	241,472
Estimated remaining life	18 yrs.	backfill trench	462,934
Elevation: -50.0 ft.		test and inspect new line	2,645
		clean and abandon old line	<u>13,439</u>
			\$3,251,713
Utility: Sewer Main			
Cost of new UTILITY		\$3,251,713	
Life of new UTILITY		50 years	
Remaining useful life of existing UTILITY		18 years	
Extension of UTILITY life	(#2-#3)	32 years	
Annual O&M of existing UTILITY		\$0	
Annual O&M of new UTILITY		\$0	
Interest rate		5.875%	
Capital recovery factor (for 50 years)	CRF (i =.05875, n=50)	0.06234	
Annual cost of new UTILITY	(#1*#8)	\$202,712	
Present worth of annuity factor for			
extension of UTILITY life (#4 years)	(uniform series present worth)	14.28221	
Benefits in year #3, credited to UTILITY life			
extension	(#9*#10)	\$2,895,172	
Single payment present worth factor for years in #3 years		0.35786	
Present worth in year 1 of UTILITY			
extension	(#11*#12)	\$1,036,100	
Annual O&M savings	(#5-#6)	\$0	
Present worth of annuity factor for #3 years	(uniform series present worth)	10.92997	
Present worth in year 1 of O&M savings (#14*#15)		\$0	
Present worth of total credit (#13+16)		\$1,036,100	
		-	
Average annual credit (benefit) (#17*#8)		\$64,590	
		-	

NED PLAN OPTIMIZATION

137. The widening features as a proposed project increment, for the entrance channel, access channel widening, and the Fisher Island turning basin extension and widening, are justified incrementally, compared to a no action alternative.

The deepening feature has also been addressed as a separate added increment compared to a no action alternative. **Table 18** (reference Table A-91 in Economics – Appendix A) summarizes the NED quantitative analysis process discussed in the Economic Appendix for the determination of the optimal depth alternative. A comparison of the marginal benefits and marginal cost of deepening in one-foot increments demonstrates that the first two feet of deepening from the current depth to 44 feet in the inner channel and 46 feet in the outer channel do not result in a positive net benefit. However, further deepening produces positive net benefits for all deepening projects through 50 feet. The net AAEQ benefits incrementally increase from 45 to 49 feet, then decrease at 50 feet. For deepening without widening the maximum net benefits optimize at 49 feet.

138. As both the widening and Fisher Island turning basin extension features, as well as the deepening features, are justified incrementally as separate elements, the next step is to determine for which alternative, when considering these features as separate elements and combinations, results in maximizing NED benefits. **Table 19** (reference Table A-92 in Economics – Appendix A) shows the comparison of AAEQ total costs and AAEQ total benefits for the deepening as an added increment (in one ft increments from 43 to 50 ft.) in comparison to the widening and Fisher Island turning basin features (Alt. Plans B and C) as stand-alone features. Alternative Plan D, which addresses widening features of the channel and turning basin as a combination, is justified within itself. The inclusion of channel deepening as an added increment, Alternative Plan H, results in higher NED benefits than plan D alone commencing at the 45 ft. proposed depth. The net NED benefits continue to increase until a project depth of 50 ft. (with 52 ft. at entrance channel). However, the NED net benefits are maximized to Alternative Plan H, at a channel system depth of 49/51 feet; this system includes widening the channel, and extending the Fisher Island Turning Basin. This combination plan has a BCR of 1.3 and net benefits of \$3,432,000.

Table 18 - Costs and Benefits of Deepening Alternatives

Deepening Project Depth	AAEQ Cost	AAEQ Benefits	Net AAEQ Benefits
43 Feet	\$4,018,057	\$2,318,124	-\$1,699,933
44 Feet	\$5,024,248	\$4,393,905	-\$630,343
45 Feet	\$5,827,317	\$6,304,350	\$477,032
46 Feet	\$6,822,987	\$7,764,694	\$941,707
47 Feet	\$7,840,297	\$8,948,121	\$1,107,824
48 Feet	\$8,629,116	\$10,070,829	\$1,441,713
49 Feet	\$9,531,963	\$11,107,049	\$1,575,086
50 Feet	\$10,386,505	\$11,162,353	\$775,848

Table 19 - Costs and Benefits of Alternative Plans

Alternative Plan	AAEQ Total Costs	AAEQ Benefits	Net AAEQ Benefits	Benefit/Cost Ratio
Alternative Plan A: No Action	\$0	\$0	\$0	n/a
Alternative Plan B: 1C Widen Entrance Channel, 2A Widener between Buoys 13 and 15, 5A Widen Fishermans Channel	\$1,455,297	\$2,580,939	\$1,125,642	1.77
Alternative Plan C: 3B Extend Fisher Island Turning Basin	\$442,877	\$1,174,043	\$731,166	2.65
Alternative Plan D: 1C Widen Entrance Channel, 2A Widener between Buoys 13 and 15, 5A Widen Fishermans Channel and 3B Extend Fisher Island Turning Basin	\$1,898,174	\$3,754,982	\$1,856,808	1.98
Alternative Plan H: 1C Widen Entrance Channel, 2A Widener between Buoys 13 and 15, 5A Widen Fishermans Channel and 3B Extend Fisher Island Turning Basin, and Deepen Channel to 43 Feet	\$5,916,231	\$6,073,106	\$156,875	1.03
Alternative Plan H: 1C Widen Entrance Channel, 2A Widener between Buoys 13 and 15, 5A Widen Fishermans Channel and 3B Extend Fisher Island Turning Basin, and Deepen Channel to 44 Feet	\$6,922,421	\$8,148,887	\$1,226,466	1.18
Alternative Plan H: 1C Widen Entrance Channel, 2A Widener between Buoys 13 and 15, 5A Widen Fishermans Channel and 3B Extend Fisher Island Turning Basin, and Deepen Channel to 45 Feet	\$7,725,491	\$10,059,332	\$2,333,841	1.30
Alternative Plan H: 1C Widen Entrance Channel, 2A Widener between Buoys 13 and 15, 5A Widen Fishermans Channel and 3B Extend Fisher Island Turning Basin, and Deepen Channel to 46 Feet	\$8,721,160	\$11,519,676	\$2,798,516	1.32
Alternative Plan H: 1C Widen Entrance Channel, 2A Widener between Buoys 13 and 15, 5A Widen Fishermans Channel and 3B Extend Fisher Island Turning Basin, and Deepen Channel to 47 Feet	\$9,738,471	\$12,703,103	\$2,964,632	1.30
Alternative Plan H: 1C Widen Entrance Channel, 2A Widener between Buoys 13 and 15, 5A Widen Fishermans Channel and 3B Extend Fisher Island Turning Basin, and Deepen Channel to 48 Feet	\$10,527,290	\$13,825,811	\$3,298,522	1.31
Alternative Plan H: 1C Widen Entrance Channel, 2A Widener between Buoys 13 and 15, 5A Widen Fishermans Channel and 3B Extend Fisher Island Turning Basin, and Deepen Channel to 49 Feet	\$11,430,137	\$14,862,031	\$3,431,894	1.30
Alternative Plan H: 1C Widen Entrance Channel, 2A Widener between Buoys 13 and 15, 5A Widen Fishermans Channel and 3B Extend Fisher Island Turning Basin, and Deepen Channel to 50 Feet	\$12,284,678	\$14,917,335	\$2,632,657	1.21

ITEMIZED COST FOR NED PLAN

139. **Table 20** displays the itemized cost displaying the general navigation features, aids to navigation, lands, easements, rights of way and relocations, and associated costs for the NED plan. The total project cost for the NED plan is \$162,290,000, including mitigation features.

Table 20 - Itemization of Cost for NED Plan

<u>Construction Item</u>	<u>Cost</u>
Dredging --	
Mob & Demob	\$2,398,312
Alternative 1C (Cut 1/2 intersection widening)	17,647,039
Alternative 1C (Cut 1)	12,294,634
Alternative 1C (Cut 2)	6,811,380
Alternative 2A (Cut 3 Widener)	289,407
Alternative 3B (Cut 3)	18,522,259
Alternative 5A (Fisherman Channel)	26,610,802
Alternative 5A (Lummus Is. Turning Basin)	25,063,386
Disposal Area (Virginia Key)	647,402
Environmental Mitigation	1,983,292
Mitigation Monitoring (Construction)	120,000
Mitigation Monitoring (Post-Construction)	150,000
Planning, Engineering, and Design	3,690,000
Construction Management (S&I)	<u>10,500,000</u>
Subtotal GNF	\$126,727,913
Aids to Navigation	165,300
Lands, Easements, Rights of Way, and Relocations	
Real Estate, Administrative (Federal)	\$12,500
Utility Relocations	\$6,106,041
Associated Non-Federal Costs	
Berthing Area Dredging (Alt. 5A)	\$6,465,283
Port Bulkhead Construction	22,800,000
Real Estate, Administrative (non-Federal)	<u>12,500</u>
	\$29,277,783
Total Project First Cost	\$162,289,537

THE LOCALLY PREFERRED PLAN

140. Projects may deviate from the National Economic Development Plan if requested by the non-Federal sponsor and approved by the Assistant Secretary of the Army, Civil Works ASA (CW). Plans requested by the non-Federal sponsor that deviate from these plans shall be identified as the Locally Preferred (LP) plan. When the LP plan is clearly of less scope and cost and meet's the Administration's policies for high-priority outputs, an exception for deviation is usually granted by ASA (CW). In such cases the LP plan must have greater net benefits than the smaller scale plans and the maximum net benefits cannot maximize at a smaller plan than the Sponsor's LP plan.

141. If the Sponsor prefers a plan that is more costly than the NED plan, and the increased scope of the plan is not sufficient to warrant full Federal participation, ASA(CW) may grant an exception as long as the Sponsor pays the difference in the cost between the NED plan and the LP plan. The LP plan must then demonstrate output similar in-kind, and equal to or greater than the outputs of the Federal plan. However, the LP plan must meet the criteria of environmental acceptability.

RECOMMENDED PLAN

142. The recommended plan for navigation improvements at Miami Harbor has to be responsive to local needs and desires as well as the economic and environmental criteria established by Federal and State law. To do this the plan must be able to handle current and forecasted vessel traffic safely with minimum impact on the environment and without excessive delays and damage. Subsequent paragraphs outline the plan design, construction, operation and maintenance procedures

143. Decision making for the selection of a recommended plan begins at the district level and continues at the Headquarters level through subsequent reviews and approval. For congressionally authorized projects, the final agency decision maker is the Secretary of the Army through the Assistant Secretary of the Army for Civil Works.

144. The NED plan has been identified as Alternative H, which optimized at a depth of 49 feet. However, the non-Federal Sponsor has requested a locally preferred plan for a channel depth of 50 ft. and an entrance channel depth of 52 ft. Post-Panamax container ships, currently deployed in the Far East trade region, have become more numerous. It is anticipated that the Post-Panamax container ships will be deployed in the Atlantic trade region and will call at U.S. East Coast ports, including the Port of Miami.